AGRICULTURAL LAND BASE STUDY:

DEVELOPMENT OPPORTUNITIES FOR THE FUTURE

ECONOMIC AND FINANCIAL ANALYSIS:
DIRECT BENEFITS AND COSTS

Alberta
Agriculture
Environment
Forestry, Lands and Wildlife
Municipal Affairs
Transportation

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FOREWORD

This document forms one of a series of technical background reports to the Agricultural Land Base Study Summary Report. The study was undertaken jointly by the Departments of Agriculture, Forestry, Lands and Wildlife, Environment, Municipal Affairs and Transportation under the guidance of a Steering Committee and its Sub-Committee, comprising representatives of the five departments, listed on page iii. This economic report examined the direct on-farm costs and benefits of a number of alternatives for increasing agricultural production. It did not evaluate off-farm costs or indirect benefits and costs.

A study of this magnitude required the involvement of many individuals and agencies. We particularly wish to recognize the major author of the report Kathleen MacDonald-Date and researchers Peter Woloshyn and Ron Desjardins. The study was done with substantial consultation with the departments involved through an Economics Working Group, chaired by Alf Birch. Contributors to specific areas of the report were Kurt Klein, Nithi Govindasamy, Alan Dooley, Tony Van Deurzen, Alison Coyne, Dianne Hope, Samuel Stochinsky, Andrew Kaggwa and Marie Diederichs.

There was valuable consultation on methodology with Professor William Phillips, University of Alberta. Technical input was provided by a number of specialists in the departments. The drainage analysis was based on data from the Inventory of Alberta's Drainage Requirements. Typing of the numerous drafts was done by Shelley Cole and June Gingras, Alberta Agriculture, editing by Marilyn Brown, Alberta Energy/Forestry, Lands and Wildlife and graphics by Ken Hemmerling, Alberta Agriculture. The maps appended to the report were produced by the Resource Evaluation and Planning Division, Alberta Energy and Natural Resources.

While appreciation is expressed for the input of all of these individuals who often operated under very tight time constraints, the responsibility for the report and the results rests solely with the Production & Resource Economics Branch.

Carlyle Ross
Branch Head
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LIST OF COMMITTEES

The members of the various committees responsible for the Agricultural Land Base Study are listed below.

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EXECUTIVE SUMMARY

The Agricultural Land Base Study (ALBS) was an interdepartmental study designed to examine eleven identified alternatives for agricultural resource development and to evaluate these for both physical and economic potential.[1]

The alternatives were[2]:

1. Green Area Conversion;
2. Irrigation Expansion;
3. Drainage;
4. Deep Plowing;
5. Liming;
6. Summerfallow Reduction;
7. Range Improvement;
8. Prairie Range Conversion;
9. Woodland Conversion;
10. Saline Soil Reclamation:
    a) Dryland
    b) Irrigated.

The direct benefits and costs analysis was carried out by the Production and Resource Economics Branch, Alberta Agriculture, with extensive review by the other departments involved. The purpose of this study was to evaluate the economic and financial feasibility of each alternative and to compare the alternatives by specific standard economic and financial criteria.

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1. Departments involved are: Agriculture, Forestry, Fish and Wildlife, Environment, Municipal Affairs and Transportation.

2. Flood control was also identified but a complete analysis was not undertaken because of the small acreage affected and insufficient economic data.

The results of economic analysis indicate whether an individual investment or change in management, at the farm level, would be beneficial to the economy. Financial analysis measures the attractiveness to the farmer. Government expenditures on infrastructure and the impact on other resource users were not examined. These are considered in other reports: Analysis of Impacts on Other Resources (Number 10); and Economic Impact Analysis (Number 11). The results of those three reports together with the Agricultural Inventory Report (Number 8) are incorporated into the Summary Report.

In the discount analysis employed, a real discount rate of 5 per cent was used and net returns reported were returns to land, labour, management and existing investment. In the financial analysis, equity was assumed to be zero for new investments. Analysis was based on representative farm sizes, ten-year average yields and prices, and representative fertilizer requirements. Sensitivity analysis tested the stability of results to changes in the major assumptions and the impact of less favourable conditions than were assumed in the base analysis. The base case for financial analysis included a residual value for land, whereas, this was only included as a sensitivity in economic analysis.

The criteria used for evaluation of alternatives were the discounted investment cost, net present value, annual equivalent cash flow and benefit cost ratio. The financial analysis also included cash flow analysis.

The discounted investment cost (DIC) reported was the initial cost associated with starting up the management change and usually represented an on-farm capital investment. This measure gives an indication of the difference in magnitude of the financial resource required to get each management alternative operational and can be used for ranking projects where there is a budget constraint.

The net present value (NPV) represented the difference between the present value of the benefit and cost streams; where the NPV is positive the project is considered to be feasible. For projects of different

investments and/or duration, it is necessary to convert the NPV's to a measure expressed in a common time frame. One such measure is the annual equivalent cash flow (AECF). This represents equal annual dollar values derived by spreading the net present value over the length of the project, while adjusting for the discount rate. When these annual values are discounted and added together they are equal to the net present value.

The benefit cost (B/C) ratio is the ratio of the present value of the benefit stream to the present value of the cost stream. Where the B/C ratio is greater than 1.0, the project is considered to be feasible. Projects are often ranked by their B/C ratio if budgets are not a constraint. Where budgets are a constraint, the B/C ratio should be considered in conjunction with the discounted investment costs, since the B/C ratio gives no indication of the absolute dollar investment. Also, by not predicting the absolute dollar return of any project the B/C ratio does not give any income expectation. The B/C ratio should therefore be used together with the net present value and/or annual equivalent cash flow when comparing projects.

These four measures were reported for all management alternatives. In some instances other measures were presented, mainly to provide some further qualifications to the evaluation. The financial internal rate of return was calculated for some alternatives.

The analysis of the management alternatives are summarized below:

1. The first alternative considered was expansion into new lands on Gray soils in the Green Area of the Peace Region. Two farm sizes were considered: 640 acres (485 cultivated acres) and 1 280 acres (960 cultivated acres). The latter proved to be the more feasible alternative. The economic AECF on the larger farm was $15 per acre and the B/C ratio 1.3. Initial investment costs were high: a DIC of $338 per acre. The financial AECF on the larger farm was -$18 per acre and the B/C ratio 0.9 after financing but before taxes.

2. The second alternative examined was irrigation expansion and intensification. Four irrigation climatic zones were considered. Both expansion and intensification sub-options proved to be feasible. Economic AECF's ranged from $41 to $178 per acre and B/C ratios ranged from 1.6 to 2.4. DIC's were also high for this alternative at $367 to $476 per acre. The financial AECF's ranged from $33 to $161 per acre and B/C ratios from 1.3 to 1.8, after financing but before taxes.

3. Drainage was the third alternative examined. Five mini-basins were examined through the Inventory Study. The results were adjusted to be compatible with the other options and weighted in proportions representative of five major basins in northern Alberta. Economic AECF's were between $16 and $59 per acre and B/C ratios between 1.2 and 1.7. DIC's were between $373 and $589 per acre. Financial AECF's ranged between $17 and $52 per acre and B/C ratios between 1.2 and 1.5, after financing but before taxes.

4. Deep plowing solonetzic soils in the Black, Dark Brown and Brown soil zones was the next alternative analysed. This proved to be most attractive on Black soils with an economic AECF of $41 per acre and a B/C ratio of 4.4. On the Dark Brown and Brown soils the economic AECF's were $14 and $12 per acre and the B/C ratios 2.1 and 2.0 respectively. This alternative had a low DIC of $93 per acre. Financial analysis after financing but before taxes produced AECF's ranging from $17 per acre on Brown to $46 per acre on Black. The corresponding B/C ratios were 1.6 to 2.5.

5. Liming acid soils was examined on the Gray, Dark Brown and Black soil zones. The returns on the Gray were slightly lower than on the others, with an economic AECF of $5 per acre and a B/C ratio of 1.7. On the other two soils, the economic AECF's were $6 and $7 per acre and the B/C ratios 1.9. DIC's were $54 per acre. The AECF's of financial analysis were $10 to $11 after financing but before taxes. Corresponding B/C ratios were 1.6 and 1.7 respectively.

6. Summerfallow reduction proved to be less attractive than the previous four alternatives. Results were negative on the Brown soil zone with an economic AECF of -$2 per acre and a B/C ratio of 0.8; the DIC was a low $12 per acre. On the other soils, economic AECF's ranged from $3 to $11 per acre and B/C ratios from 1.2 to 1.6. DIC's were $15 to $16 on Gray and Black soils, and $31 per acre on the Dark Brown. The financial AECF's, after financing but before taxes, varied from -$2 per acre on Brown soils to $12 on Black (Central). B/C ratios were between 0.9 and 1.6.

7. The next alternative examined was range improvement of both prairie and woodland range. Prairie range improvement involving breaking and reseeding to tame pasture had economic AECF's of $0, $15 and $24 per acre, and B/C ratios of 1.0, 1.2 and 1.3 on Brown, Dark Brown and Black soils respectively. DIC's were $65 per acre for the land improvement. Woodland improvement involved clearing, breaking and seeding plus fencing and fertilizing. The economic AECF's were -$9 and -$7 per acre on the Black soils and Gray respectively. B/C ratios were 0.95 and 0.96, and both DIC's were $279 per acre. Financial analysis produced similar results, with AECF's after financing but before taxes of $1 to $21 per acre, and B/C ratios of 1.1 to 1.3 for prairie range improvement. Woodland range improvement had AECF's of -$11 and -$12 per acre and B/C's of 0.97 after financing but before taxes.

8. Range conversion to cropland was examined with the assumption of a reduced herd size. Economic AECF's were $29 per acre on Brown, $43 per acre on Dark Brown, $40 per acre on Black and $34 per acre on Gray. B/C ratios were 2.0 on Brown, 2.1 on Dark Brown, 1.8 on Black and 1.9 on Gray. DIC's were $52 per acre on Brown, $173 on Dark Brown, $78 on Black and $88 on Gray. Financial AECF's ranged from $28 to $41 per acre and B/C ratios from 1.4 to 1.6 after financing but before taxes.

9. Woodland conversion to cropland, on existing farms, was analysed for the Black and Gray soils. On the Black soils results were quite high, with an economic AECF of $50 per acre and B/C ratio of 1.7. Results for Gray were lower, with an economic AECF of $22 per acre and B/C ratio of 1.4. The DIC's were $214 per acre. The financial AECF's after financing but before taxes were $57 per acre on Black and $26 per acre on Gray, with B/C ratios of 1.6 and 1.3 respectively.

10. The final alternative considered was reclamation of saline soils on both dryland and irrigated land. Vegetative reclamation on dryland had an economic AECF of $1 per acre, B/C ratio of 1.2 and a DIC of $63 per acre. After financing but before taxes, the financial AECF was $19 per acre and the B/C ratio 1.3. Drainage of irrigated saline soils was examined for three irrigation districts and two levels of salinity. Economic AECF's were in the vicinity of $35 to $57 per acre and B/C ratios were 1.2 to 1.3. The Bow River Irrigation District with a medium level of salinity had the highest values. DIC's were high at $523 per acre. Financial AECF's before financing but after taxes were between $29 and $52 per acre. The respective B/C ratios were 1.1 to 1.2.

The management alternatives examined were evaluated using several criteria based on direct on-farm benefits and costs. The AECF was chosen as the measure best suited for comparing alternatives of varied size and lengths. The economic and financial AECF's are summarized on the next two pages. The results include neither government expenditure on infrastructure nor the opportunity cost of other uses foregone. The infrastructure costs are particularly important for irrigation expansion and Green Area conversion. The economic and financial B/C ratios are also provided following the AECF summaries.

TABLE 1

ECONOMIC AECF'S BY ALTERNATIVES[1]

Alternative[2]	Level of Investment (DIC)[3]	Brown	Dark Brown	Black	Gray
		----(economic AECF/acre)-----			
1. Green Area Conversion	338-429	-	-	-	15
2. Irrigation Expansion					
Intensification (A1)[4]	476	178	-	-	-
(A2)	476	120	-	-	-
(B)	476	-	98	-	-
(C)	476	-	57	-	-
Expansion (A1)	367	130	-	-	-
(A2)	367	87	-	-	-
(B)	367	-	71	-	-
(C)	367	-	41	-	-
3. Drainage					
Peace	373	-	-	-	31
Athabasca	453	-	-	-	22
Beaver	502	-	-	-	16
North Saskatchewan	554	-	-	50	-
Battle	589	-	59	-	-
5. Deep Plowing Solonetzic Soils	93	12	14	41	-
6. Liming Acid Soils	54	-	6	7[5]	5
7. Summerfallow Reduction	6-31	-2	9	11, 5[5]	3
8. Range Improvement (Prairie)	65	0	15	24	-
(Woodland)	279	-	-	-9	-7
8. Range Conversion	52-173	29	43	40	34
9. Woodland Conversion	214	-	-	50	22
10. Reclamation of Saline Lands (Irrigated)	523	57	-	-	-
(Dryland)	63	1	-	-	-

1. Government expenditure on infrastructure and opportunity costs of non-agricultural uses not included.
2. Residual value not included. For more details see Section 12.
3. Discounted investment cost.
4. Irrigation climatic zones.
5. Black soils in the Northeast region.

TABLE 2

FINANCIAL AECF'S BY ALTERNATIVES[1]

Alternative[2]		Brown	Dark Brown	Black	Gray
		----(financial AECF/acre)[3]---			
1. Green Area Conversion		-	-	-	-18
2. Irrigation Expansion					
Intensification	(A1)[4]	161	-	-	-
	(A2)	103	-	-	-
	(B)	-	80	-	-
	(C)	-	43	-	-
Expansion	(A1)	121	-	-	-
	(A2)	78	-	-	-
	(B)	-	60	-	-
	(C)	-	33	-	-
3. Drainage					
Peace		-	-	-	31
Athabasca		-	-	-	23
Beaver		-	-	-	17
North Saskatchewan		-	-	45	-
Battle		-	52	-	-
4. Deep Plowing Solonetzic Soils		17	19	46	-
5. Liming Acid Soils		-	11	11[5]	10
6. Summerfallow Reduction		-2	10	12, 5[5]	4
7. Range Improvement					
(Prairie)		1	13	21	-
(Woodland)		-	-	-12	-11
8. Range Conversion		28	41	39	36
9. Woodland Conversion		-	-	57	26
10. Reclamation of Saline Lands	(Irrigated)	52	-	-	-
	(Dryland)	19	-	-	-

1. Government expenditure on infrastructure and opportunity costs of non-agricultural uses not included.
2. For more details see Section 12.
3. After financing but before taxes (with residual land value).
4. Irrigation climatic zones.
5. Black soils in the Northeast region.

TABLE 3

ECONOMIC B/C RATIOS BY ALTERNATIVES[1]

Alternative[2]	Level of Investment (DIC)[3]	Brown	Dark Brown	Black	Gray
		----(economic B/C ratio)----			
1. Green Area Conversion	338-429	-	-	-	1.3
2. Irrigation Expansion					
Intensification (A1)[4]	476	2.4	-	-	-
(A2)	476	2.0	-	-	-
(B)	476	-	1.9	-	-
(C)	476	-	1.6	-	-
Expansion (A1)	367	2.3	-	-	-
(A2)	367	2.0	-	-	-
(B)	367	-	1.9	-	-
(C)	367	-	1.6	-	-
3. Drainage					
Peace	373	-	-	-	1.5
Athabasca	453	-	-	-	1.3
Beaver	502	-	-	-	1.2
North Saskatchewan	554	-	-	1.6	-
Battle	589	-	1.7	-	-
4. Deep Plowing Solonetzic Soils	93	2.0	2.1	4.4	-
5. Liming Acid Soils	54	-	1.9	1.9[5]	1.7
6. Summerfallow Reduction	6-31	0.8	1.3	1.6,1.3[5]	1.2
7. Range Improvement (Prairie)	65	1.0	1.2	1.3	-
(Woodland)	279	-	-	1.0	1.0
8. Range Conversion	52-173	2.0	2.1	1.8	1.9
9. Woodland Conversion	214	-	-	1.7	1.4
10. Reclamation of Saline Lands (Irrigated)	523	1.3	-	-	-
(Dryland)	63	1.2	-	-	-

1. Government expenditure on infrastructure and opportunity costs of non-agricultural uses not included.
2. Residual value not included. For more details see Section 12.
3. Discounted investment cost.
4. Irrigation climatic zones.
5. Black soils in the Northeast region.

TABLE 4

FINANCIAL B/C RATIOS BY ALTERNATIVES[1]

Alternative[2]		Brown	Dark Brown	Black	Gray
		----(financial B/C ratio)[3]---			
1. Green Area Conversion		-	-	-	0.9
2. Irrigation Expansion					
Intensification	(A1)[4]	1.8	-	-	-
	(A2)	1.6	-	-	-
	(B)	-	1.5	-	-
	(C)	-	1.3	-	-
Expansion	(A1)	1.8	-	-	-
	(A2)	1.6	-	-	-
	(B)	-	1.5	-	-
	(C)	-	1.3	-	-
3. Drainage					
Peace		-	-	-	1.5
Athabasca		-	-	-	1.3
Beaver		-	-	-	1.2
North Saskatchewan		-	-	1.4	-
Battle		-	1.4	-	-
4. Deep Plowing Solonetzic Soils		1.6	1.6	2.5	-
5. Liming Acid Soils		-	1.6	1.7[5]	1.6
6. Summerfallow Reduction		0.9	1.3	1.6,1.3[5]	1.3
7. Range Improvement					
(Prairie)		1.1	1.3	1.3	-
(Woodland)		-	-	1.0	1.0
8. Range Conversion		1.5	1.6	1.4	1.6
9. Woodland Conversion		-	-	1.6	1.3
10. Reclamation of Saline Lands	(Irrigated)	1.2	-	-	-
	(Dryland)	1.3	-	-	-

1. Government expenditure on infrastructure and opportunity costs of non-agricultural uses not included.
2. For more details see Section 12.
3. After financing but before taxes (with residual land value).
4. Irrigation climatic zones.
5. Black soils in the Northeast region.

The previous tables summarized the ten alternatives evaluated in this study. Three of the major economic criteria used for evaluation are presented in these tables (AECF, B/C ratio and level of investment). Projects may change their relative attractiveness depending on the criteria used (i.e.: level of investment, return per dollar invested or absolute return per acre). In some cases a project may have a high return per acre but the level of investment required may also be high.

While most management alternatives examined proved to be both economically and financially feasible, there were several differences in levels of investment, expected return per acre and expected return per dollar invested. These variations existed both between alternatives and within alternatives. No single alternative had a combination of the best score for all three criteria used to evaluate the projects. On the basis of low investment cost and high return per dollar (B/C ratio), deep plowing scored highest, but the return per acre was in the middle range. Whereas, on the basis of high return per dollar (B/C ratio) and highest return per acre (AECF), irrigation expansion scored highest, but the investment cost was high.

Under all combinations of criteria, woodland range improvement scored the lowest, having high investment costs, B/C ratios less than one and negative AECF's. Dryland saline reclamation and Green Area conversion had low B/C's and AECF's, but the former involved low investment costs and the latter high investment costs. These results support the necessity for using a number of criteria to evaluate the alternatives under study. No single measure is appropriate for ranking.

Sensitivity analysis involving reasonable variations in the major assumptions showed that the results were quite stable. Where a combination of adverse conditions (such as yield and price reductions plus higher costs or higher discount rates) was assumed, many alternatives were no longer feasible. Although this combination of conditions is unlikely, it gives some indication of how extreme conditions must become to change the base results significantly.

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I. INTRODUCTION

1.1 Background

The major objective of the Agricultural Land Base Study was to examine eleven identified alternatives for agricultural resource development and to rank them for both physical and economic potential. The aims of the study were to undertake a physical inventory of expansion and intensification potential, and evaluate the direct and social costs and benefits of each alternative.

This study, the first phase of the economic component, examines the direct costs and benefits related to each alternative except flood control. The economic impact on other resource users and the secondary impact of each alternative are examined in the second phase of the economic component. A brief comment on flood control is included in that report. Both economic studies are presented in the summary report. Standard economic and financial analysis methodology was employed to determine the economic and financial feasibility of each alternative and to rank the alternatives according to investment costs, annual equivalent cash flows, benefit cost ratios and other measures of economic performance.[1]

The economic analysis results are from the provincial economy's point of view and not necessarily a farmer's point of view. This analysis indicates whether or not a particular investment or change in management at the farm level is economically feasible. On-farm financial and cash flow considerations were taken into account in the financial analysis. Taxes, grants and other transfer payments which were excluded from the economic analysis were evaluated in the financial analysis.

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1. Aplin, R.D., G.L. Casler and C.L. Francis. Capital Investment Analysis, Using Discounted Cash Flows. Grid Publishing, Inc., Columbus.
   Gittinger, J.P. 1972. Economic Analysis of Agricultural Projects. The Economic Development Institute of the World Bank. The John Hopkins University Press.

These could have significant implications for net benefits and, more particularly, cash flows of the projects from the farmer's point of view. Total costs and benefits of each management alternative were examined through economic analysis, while the farmer's share of these costs and benefits were examined through financial analysis.

The reader is cautioned that the results of both the economic and financial analyses relate to a set of specific assumptions and are not applicable globally. The conclusions drawn on the feasibility of adoption of a management change are based on a given farm size, crop mix, input combination, yields, input costs and output prices. Sensitivity analysis was done to examine the outcome under different price regimes, yield variations and changes in other variables. These should be used in conjunction with the results from the main analysis. The analysis takes into account all costs and benefits of each alternative at the farm level. It must be noted that with some of the alternatives considerable government expenditure in infrastructure might be needed. These alternatives include expansion into the Green Area and irrigation expansion.

Finally, other factors that might restrict adoption of a number of the management alternatives have not been taken into account. These include market restrictions (e.g. quota); alternate use of capital (on-farm and personal); availability of credit; government or other restrictions; environmental concerns and other externalities (including aversion to risk and other farmer related characteristics). The financial analysis includes a cost of credit, but assumes that it will be available.

1.2 Methodology and Assumptions

(i) Marginal analysis was employed for all projects. Performance criteria used were benefit cost ratio (B/C), net present value (NPV) and annual equivalent cash flow (AECF). The internal rate of return (IRR) was also reported in some instances. A discounted investment cost (DIC) was reported for each alternative. This is the initial cost associated with starting up the project or making the change in management. In most alternatives, this represented a capital investment. In a few cases where there was no specific investment cost, it represented the total increase in costs in the first year of the management change.

(ii) Economic and financial analyses were employed. The economic results are presented from the total economy's point of view and the financial results from the individual farmer's point of view. Residual land values were included in the financial, but not in the economic base cases. The converse was tested through sensitivity analysis. No shadow pricing was undertaken.

(iii) The main analytical tools used were two whole-farm simulation computer models (for dryland cereal and oilseed production, and for beef, forage and grain production in western Canada); and I.P. Sharp's version of APL and the IBM-PC with the LOTUS software package for analysis.

(iv) A real discount rate of 5 per cent was used. This was based on a nominal interest rate of 12 to 15 per cent and an inflation rate of 7 to 9 per cent. The analysis assumed a constant relationship between costs and product prices.

(v) Transfer payments, including taxes and subsidies, crop insurance, Western Grain Stabilization payments, interest on operating and investment capital, and annual incremental operating capital were evaluated in converting from economic to financial analysis.

(vi) Net returns reported were returns to land, labour, management and existing investment. Only incremental labour requirements resulting from the adoption of a management alternative were costed, at $6.00 per hour.

(vii) Representative farm sizes (cultivated acres) and crop mixes were determined for the dryland crop management alternatives by the major soil zones (see Figure 1 and Table 5). This was done by examining census data, agriculture year book data and CRD's, and by obtaining informed estimates from specialists in each region. Various crop rotations were examined in each soil zone. Typical base cattle-grain farms were determined for the rangeland conversion alternative, while the irrigation intensification and expansion alternative was based on 10 000-acre blocks, with average crop mix by irrigation climatic zone. For some alternatives, only a specified affected area was analysed, rather than the whole farm.

FIG. 1

Soil Zone Map of Alberta

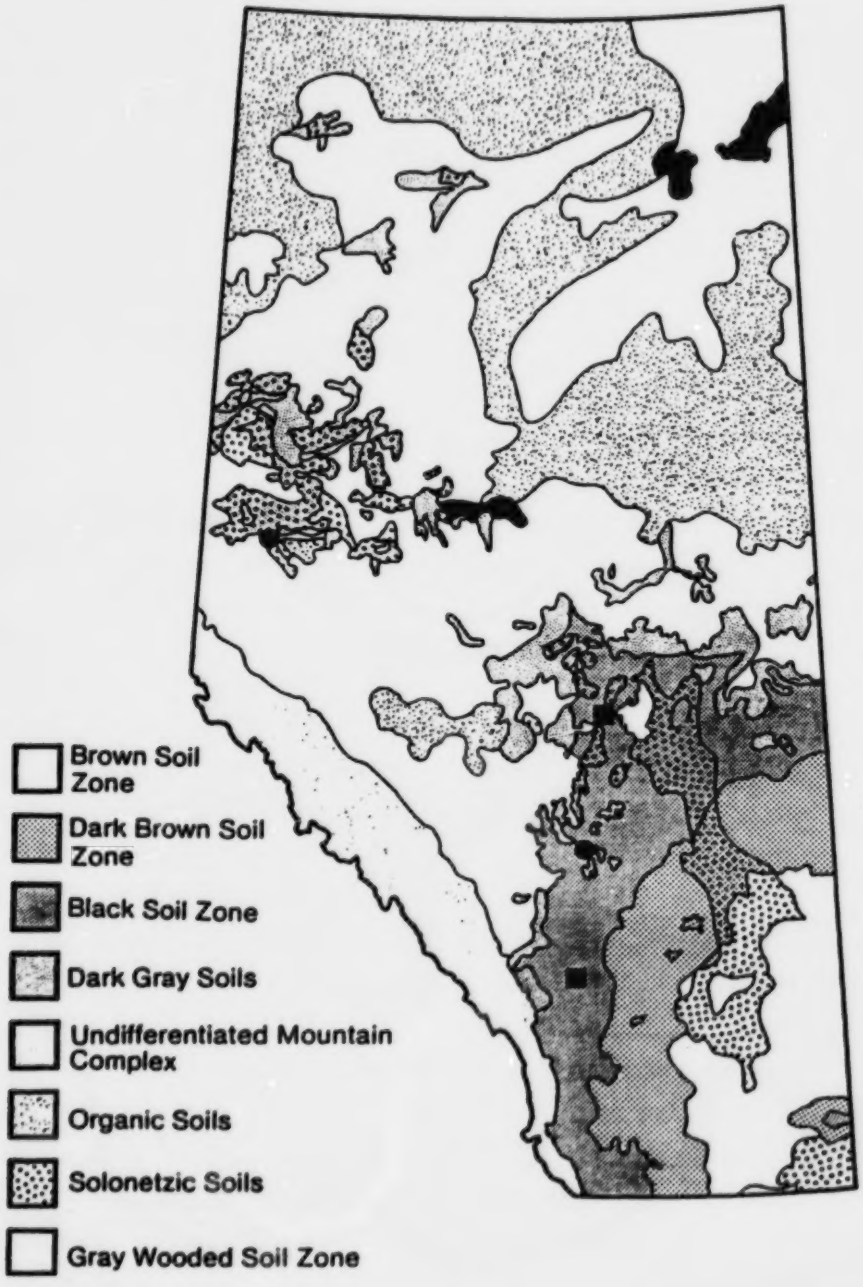

TABLE 5

FARM SIZE AND CROP MIX DATA[1]

Soil Zone	Cultivated Acres (ac.)	Crop Mix[2] Wheat (%)	Barley (%)	Canola (%)	Oats (%)
Brown	1 500	100	--	--	--
Dark Brown	1 110	57	30	13	--
Black (Central)	600	15	50	25	10
Gray[3] (Peace River)	600	21	48	31	--

1. Based on census and agriculture yearbook data and informed estimates.

2. Represents percentage of cropped area (i.e. excludes summerfallow acres).

3. Gray soils, in this report, refers to Luvisols, formerly Gray and Dark Gray Wooded soils.

(viii)Ten year average output prices (1973 to 1982) expressed in 1982 dollars were assumed. Ten year average (1973 to 1982) yields were used as bench marks for the crop management alternatives. These are summarized in Table 6. Variations from these yields caused by problems such as acid soils, were based on experimental results, previous studies and communication with appropriate specialists.

(ix)Fertilizer requirements per soil zone used in the dryland crop management studies are reported in Table 7.

(x)For financial analysis, zero equity and an interest rate of 13 per cent was assumed for all new investments except where otherwise stated. All grants and subsidies, for which farmers undertaking the alternatives are eligible, were evaluated. Crop insurance claims were assumed to be twice the value of crop insurance payments, based

TABLE 6

TEN YEAR AVERAGE YIELDS AND PRICES

Soil Zone	Ten Year Average Yields[1] and Prices[2]							
	Wheat		Barley		Canola		Oats	
	Fa.	St.	Fa.	St.	Fa.	St.	Fa.	St.
	$5.02		$2.80		$7.86		$1.72	
	(bu/ac)							
Brown	25.6	17.9	-	-	-	-	-	-
Dark Brown	33.5	28.5	51.9	45.1	24.5	20.7	58.2	47.9
Black (Central)	36.1	30.9	54.0	46.2	25.2	21.9	69.4	57.5
Gray (Peace River)	30.6	25.7	40.7	33.1	18.4	14.5	55.4	48.2

1. Data obtained from Statistics Canada and Alberta Hail and Crop Insurance Corporation.
2. Ten year average output prices (1973 to 1982) expressed in 1982 dollars (using the Index of Farm Prices of Agricultural Products).

TABLE 7

FERTILIZER REQUIREMENTS BY SOIL ZONE[1]

Soil Zone	Fallow		Stubble	
	N	P	N	P
	(lbs/acre)			
Brown	7.5	16.0	22.0	16.0
Dark Brown	14.5	13.5	31.0	18.0
Black (Central)	14.0	21.0	38.0	21.0
Gray (Peace River)	13.0	18.0	32.5	18.0

1. Based on personal communications with Soil & Feed Testing Laboratory and Soils Branch, Alberta Agriculture.

on the federal government subsidization of the program.[1] Western Grain Stabilization benefits and payments were assumed to be equal except in the case of Green Area conversion. Annual incremental operating capital was valued at 85 per cent of the change in costs for the next year. Salvage value of new equipment was based on the undepreciated value at the end of the project. Where appropriate, residual land values were assumed to be equal to the total improvement cost. Capital cost allowance was calculated for determining income tax payments and a marginal tax rate of 20 per cent was assumed.

(xi) Sensitivity analysis was carried out with price, yield and discount rate variations for all economic analyses. Other specific sensitivity analyses were done where appropriate. For financial analysis, changes in discount rates, marginal tax rates and residual values were tested through sensitivity analysis.

1.3 Explanation of Terms and Procedures

1.3.1 Evaluating Agricultural Investment Alternatives

The basis for economic or financial evaluation of alternative projects is a comparison of costs and benefits to determine which alternative gives a greater return for money invested. Because different alternatives last for different times, of more than one year, and because future cost and benefit streams are not consistently shaped between projects, it is necessary to take time into account and not compare solely on the basis of undiscounted costs and benefits.

---

1. Alberta Hail and Crop Insurance Corporation, 16th Annual Report; year ended March 31, 1984.

Discounting is the technique whereby all future benefits and cost streams are reduced to their present worth or value. Comparisons of the present worth of various projects, or ratios of present worths and costs are used for ranking projects or investment alternatives, taking timing into account.

The purpose of discounting is to determine whether using money in an investment will yield more cash than using the money another way. Other methods are usually more appropriate for accounting for uncertainty and inflationary trends.

The three discounted measures commonly used for evaluating agricultural projects are: benefit cost ratio, net present worth or value, and internal rate of return. Projects are considered viable where the B/C ratios are 1.0 or greater, or where the NPV's are positive. Neither of these can be relied upon to rank the projects that are accepted as viable; they simply tell whether to accept the whole group.

Although in practice projects with higher B/C ratios are often regarded as preferable (other things being equal), ranking by B/C ratio can lead to erroneous investment choices. The B/C ratio discriminates against projects with relatively high gross returns and operating costs, even though these may be shown to have a greater wealth generating capacity than alternatives which have a higher B/C ratio.

For example, drainage of irrigated saline lands with B/C ratios of 1.2 to 1.3 would be ranked below liming acid soils with B/C ratios of 1.7 to 1.9. This is so despite drainage having a much higher NPV of over $500 per acre when compared with $37 to $50 per acre for liming.

Secondly, different netting out conventions or procedures can change the value of the ratios. Where projects of different scale of change are being evaluated, different costs and benefits are evaluated. The B/C for irrigation expansion and for expansion into the Green Area are based on total farm costs and benefits and are not strictly

comparable with those of the other alternatives which are based on a truly marginal change. Thus, while no costs were netted out in the first two alternatives, a certain amount of netting out of existing costs is implicit in the other alternatives.

No ranking of acceptable alternative projects is possible with the NPV criterion. This is an absolute, not a relative measure. A small, highly attractive project may have a smaller NPV than a large, marginally acceptable project. As long as both have positive NPV's, both are viable. If for any reason one must be chosen, then the NPV is an unreliable indicator. Expressing NPV's on a per acre basis reduces, but does not eliminate the problem.

Also if projects are of different lengths, then NPV's cannot be compared. Adjustments are required for comparing projects of unequal life. Three common approaches are: analysing, using common terminal data (with terminal values); viewing each project as having a continuous replacement cycle; and determining annual equivalent cash flows. The last approach also involves the implicit assumption of a continuous replacement cycle. The annual equivalent cash flow per acre makes projects of different size, scale and life more comparable and is considered the most appropriate measure for ordering alternatives for purposes of this study. To select among projects, however, total costs and scale of the project, off-farm costs and impacts still need to be considered.

1.3.2 Definitions

(i)Marginal economic analysis involves discounting the incremental costs and benefits, with and without a change in management, to their present value.

(ii)Discounting takes the time value of money into account and expresses cost and revenue streams in present value terms.

(iii)Discount rate is the rate assumed for discounting and it reflects a time preference for money or the opportunity cost of money.

(iv) Real discount rate is the nominal or observed rate adjusted for inflation.

(v) Net present value is the present value or worth of the cash flow stream, or the difference between the present worth of the benefit stream and the present worth of the cost stream.

NPV = Sum of Discounted Benefits − Sum of Discounted Costs

$$= \sum_{t=1}^{n} \frac{B_t - C_t}{(1+i)^t}$$

(vi) Benefit cost ratio is the ratio of the present worth of benefits to the present worth of costs.

$$\text{B/C Ratio} = \frac{\text{Sum of Discounted Benefits}}{\text{Sum of Discounted Costs}}$$

$$= \frac{\sum_{t=1}^{n} \frac{B_t}{(1+i)^t}}{\sum_{t=1}^{n} \frac{Ct}{(1+i)^t}}$$

(vii) Internal rate of return is the discount rate which just makes the net present worth of the cash flow equal to zero (i.e. the rate at which the present worth of the benefits equals the present worth of the costs). It represents the average earning power of money used in the project over the project life.

IRR = Discount rate such that:

Sum of Discounted Benefits − Sum of Discounted Costs = 0

$$= \sum_{t=1}^{n} \frac{B_t - C_t}{(1+i)^t} = 0$$

(viii)Annual equivalent cash flow represents the annual amount for a given number of years (n), which has a present value equal to the NPV of the particular investment. It is derived by dividing the NPV by the appropriate discount factor for the corresponding number of years and discount rate. Fluctuations in cash flow are removed by averaging, but the time value of money is taken into account in deriving the average.

$$AECF = \frac{NPV}{\text{Discount factor (for 'n' years)}}$$

The concept is similar to that of an annuity or to the annual receipt from investing a given dollar amount (equal to the NPV) for a given number of years (equal to the project life) at a given interest rate (discount rate).

e.g. $\frac{\$1\ 000}{12.462} = \$80.24$ per annum

where 12.462 is the discount factor for 20 years and a 5 per cent discount rate

Thus, $1 000 invested for 20 years at 5 per cent has an annual equivalent cash flow of $80.24. Similarly, an agricultural investment with an NPV of $1 000 and a project life of 20 years has an AECF of $80.24, at a 5 per cent discount rate.

(ix)Economic analysis provides insight into whether a proposed (agricultural) project is beneficial to the economy as a whole.

(x)Financial analysis assesses whether the project participants (e.g. farmers) will have sufficient incentive and suitably timed cash flows to participate willingly in the project. Analysis can be done at the level of all resources (before financing), at the level of the farmer's resources (after financing but before taxes) and at the level after financing and taxes.

2. GREEN AREA CONVERSION

2.1 Objectives

(i)To determine the economic feasibility of agricultural expansion into new lands in the Green Area of the Peace region.

(ii)To evaluate the financial feasibility of expansion into Green Area lands.

2.2 Methodology and Assumptions

2.2.1 Economic Analysis

To determine the on-farm benefits and costs of expansion into new lands, the following methods and assumptions were used:

(i)A whole-farm computer simulation model which generates production costs for major crop rotations was used in the analysis[1].

(ii)The method of analysis (marginal economic analysis) and asumptions related to crop mix, yields, prices and inputs, outlined in the Introduction, apply to this study except where otherwise stated.

(iii)The farm sizes used for this study were 640 acres (485 cropped) and 1 280 acres (960 cropped). These farms were evaluated using two crop rotations, 1/4-3/4 and continuous cropping (C/C).

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1. Zentner, R.P., et.al., "A Simulation Model for Dryland Crop Production in the Canadian Prairies", Agricultural Systems, Volume 3, No. 4, 1978, 241-257.

(iv)Typical machinery complements were chosen for each farm size. The machinery used was assumed to be two years old and valued at 50 per cent of new cost (1982)[1]. Used equipment was replaced every ten years and new equipment was replaced every twelve years. The total cost of the machinery replacement was averaged over 20 years.

(v)Land development was phased in over six years for the 640-acre farm and seven years for the 1 280-acre farm (Table 8). Per acre land development costs were made up of:

Clearing and piling	$ 90.00
Breaking and working down	140.00
Total	$230.00

The land purchase cost was treated as a transfer payment and not included in the economic analysis.

TABLE 8

PHASE-IN PERIOD FOR LAND DEVELOPMENT

Farm Size	Cultivated	Year						
---------(acres)---------		(1)	(2)	(3)	(4)	(5)	(6)	(7)
640	485	0	0	200	295	390	485	485
1 280	960	0	0	300	465	630	795	960

(vi)Canola was grown on all summerfallow acres up to year seven for both the 485- and 960- (cropped) acre farms. After year seven, fallow acreage was allocated to both canola and wheat according to the crop mix for the study area (given in the Introduction).

1. Production Economics Branch, Farm Machinery Costs, 1982.

(vii) Sensitivity analysis was carried out to measure the economic impacts of fluctuations in the major variables as follows:

a] Discount rate: 5 per cent ± 2 per cent;

b] Yield and output prices: ± 10 and 20 per cent;

c] Capital investment costs ± 10 per cent;

d] Production costs: ± 10 per cent;

e] New and used equipment costs; and

f] Residual value of land included.

2.2.2 Financial Analysis

This alternative involved the establishment of a new farm and therefore entailed a whole farm analysis, rather than analysis of a marginal investment or change in management. Thus, certain transfer payments, netted out or not included in the other alternatives, were evaluated. To determine whether farmers have sufficient incentive and suitably timed cash flows to make the investment in expansion into Green Area lands, the following transfer payments were evaluated for farms of 485 acres and 960 acres.

Inflows

(i) Producers who improve their land in this way are eligible for a land improvement grant. This grant is received annually for five years. Each annual receipt is the lowest of either $700, 7 per cent of the investment or the interest payments of the investment.[1]

(ii) Receipts from Western Grain Stabilization (WGS) were estimated with the help of WGS.[2] No payments or receipts would have been made prior to development.

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1. Loree, Wilson J., Assistance Available for Alberta Farmers, Alberta Agriculture, Agdex 871, 1985.

2. Personal communications with Western Grain Stabilization Program personnel.

(iii) Crop insurance claims were assumed to be twice the amount of the crop insurance payments, based on the federal government subsidization of the program.[1]

(iv) To be consistent with other alternatives examined, equity was assumed to be zero on any capital investment required, that is, the investment required by this project was assumed to be financed totally by borrowings. Sensitivity was done at 10, 20 and 30 per cent equity.[2]

(v) Residual value was assumed to be equal to the sum of all land improvement costs. A value of zero was used as a sensitivity. The cost of land purchase was recaptured at the end of the project in both cases.

(vi) It was assumed that all assets were salvaged in the last year of the project. The salvage value at that time was based on the undepreciated portion of the buildings and equipment at the end of the project.

(vii) Sensitivity analysis was done excluding crop insurance subsidies and land improvement grants.

Outflows

(viii) Annual WGS payments were estimated with the help of WGS.

(ix) Land purchase costs were included in the initial investment.

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1. Alberta Hail and Crop Insurance Corporation, 16th Annual Report; year ended March 31, 1984.

2. The minimum requirement for a Beginning Farmer Loan is 10 per cent equity in the form of cash or net worth in productive assets.

(x) For simplicity, the Alberta Agricultural Development Corporation (ADC) Beginning Farmer Loan Program (with the Staged Option) was assumed for the first $200 000 of the investment. This program includes a 6 per cent rebate or reduction on the outstanding principal balance, and an amortization period of 30 years.[1] The Staged Option provides for two loans, not exceeding a total of $200 000, made within four years of each other. The balance of funding required was provided through loans at 13 per cent interest and a 30-year repayment period. Sensitivity was done with a 13 per cent rate for all funds required.[2]

(xi) Annual incremental operating capital was valued at 85 per cent of the change in costs for the next year.

(xii) Income tax was calculated based on the tax calculation equation supplied in the General Tax Guide of 1982. Capital cost allowance for tax purposes was based on a declining balance and calculated using a rate of 15 per cent for self-propelled equipment and 10 per cent for tillage equipment.[3]

(xiii) Crop insurance payments were calculated based on soil zone, land class, crop mix and 60 per cent coverage with the high price alternative. These estimates were derived using information supplied by the Alberta Hail and Crop Insurance Corporation. In each soil zone a representative county or municipality was chosen to provide an estimate of the percentages of A, B, C, D and E land.

---

1. Amortization periods, for purposes other than land purchases, are usually shorter. However, the same conditions were assumed for the entire development loan.

2. In reality, the total funding required for this type of investment (over $400 000 for the 960-acre farm) would not be available to a single proprietor farmer, within the phasing-in period of 6 years used in this analysis.

3. Revenue Canada, Farmer's Income Tax Guide, 1982.

(xiv) Property taxes were included, assuming zero tax before the project.

2.3 Results

2.3.1 Economic Analysis

Results expressed as net present value (NPV), annual equivalent cash flow (AECF) and benefit/cost ratio (B/C) are summarized in Table 9. Farms with 485 and 960 cropped acres, were evaluated under two rotation strategies: 1/4-3/4 and continuous cropping. All four of these base cases showed positive NPV's and B/C ratios greater than 1.0, indicating that from an economic standpoint expansion into wooded land was feasible. In all cases the larger farm size (960 cropped acres) proved to be the more economically viable alternative. The 960-acre farm had smaller investment costs per acre (combined equipment and land development), compared to the 485-acre farm. For each farm size, continuous cropping (C/C) resulted in larger NPV's. Therefore, the remainder of the discussion will relate to the C/C alternative for both the 485- and 960-acre farms.

The B/C ratios for the 485- and 960-acre farms were 1.12 and 1.23 respectively for the base scenario (both B/C's are fairly marginal). The high initial investment costs prevent a positive net revenue until the fifth year for the 485-acre farm and the sixth year for the 960-acre farm. Discounted capital investment costs for the 485- and 960-acre farms were $429 and $344 per acre respectively. While much of this investment was made early in the project, the annual equivalent capital investments were $28 and $22 per acre for the 485- and 960-acre farms respectively over the life of the project of 30 years. The annual capital investment costs per acre for the first six years were considerably higher at $84 and $63 respectively for the 485- and 960-acre farms. A capital repayment scheme over 15 to 25 years is required to offset the severe cash flow problems in years 1 to 6 of the project.

TABLE 9

ECONOMIC PERFORMANCE MEASURES FOR GREEN AREA CONVERSION[1]

Results	DIC	NPV	AECF	B/C
	--------($/acre)-------			(ratio)
1. 485 acres cult. (1/4-3/4)	423	122.93	8.00	1.12
2. 960 acres cult. (1/4-3/4)	338	222.89	14.50	1.26
3. 485 acres cult. (continuous cr.)	429	145.55	9.47	1.12
4. 960 acres cult. (continuous cr.)	344	242.34	15.76	1.23

1. Based on 5 per cent discount rate, 10-year average yields and prices and project life = 30 years.

The B/C ratios and AECF's were quite responsive to changes in most of the major variables (i.e. yield, price, input costs and discount rates). A 7 per cent discount rate forced the B/C ratio down to 1.05 (close to the break even level) for the 485-acre farm; however, a smaller effect was shown for the 960-acre farm (B/C dropped from 1.23 to 1.16). With a 10 per cent decrease in gross revenue, the 485-acre farm barely broke even (B/C = 1.01, AECF = $0.72/acre) and the B/C ratio and AECF/acre were reduced to 1.11 and $7.32 respectively for the 960-acre farm. A 20 per cent reduction in gross revenue forced the B/C ratio below 1.0 for both farm sizes. Investment and production cost increases had similar effects on the B/C ratios. The B/C ratio was reduced from 1.12 to 1.07 for the 485-acre farm, with a 10 per cent increase in either investment or production costs. The B/C ratio was reduced from 1.23 to 1.18 and 1.16 for investment and production cost increases of 10 per cent for the 960-acre farm. Land costs were excluded from the analysis since it was a transfer payment to the Crown.

The age and value of the investment in equipment was critical to the study. The base scenario included the value of used equipment. This equipment was valued at 50 per cent of the retail purchase price and was assumed to be two years old.[1] For purposes of sensitivity analysis a new equipment cost was used. With this increased investment cost, the 485-acre farm showed the AECF per acre drop from $9.47 to -$15.56. The 960-acre farm was able to just break even with the B/C ratio equal to 1.0 and the AECF per acre equal to zero. In the base case, the value of land was included in the net benefit; no residual or end value and no opportunity cost were shown for the land cleared. Further sensitivity analysis was done to show the impact of including a residual value for land. For the 485-acre C/C farm, where a residual value for agricultural land was included, the B/C ratio increased to 1.26. The figure for the 960-acre C/C farm was 1.41. For more details on sensitivity analysis, refer to Appendix I.

2.3.2 Financial Analysis

An analysis of the cash flows before financing showed that flows would be negative in the first four or five years of the project, depending on the scale of expansion. For the smaller farm size, negative flows ranged from $19 to $164 per acre per annum ($9 000 to $80 000 for 485 acres). The values for the larger farm were $5 to $132 per acre ($5 200 to $126 000 for 960 acres).

When financing was included in the analysis, negative flows were spread over the entire project life, with positive flows in only a few years. During the first 15 years of the project, flows ranged from +$12 to -$33 per acre on the smaller farm and +$6 to -$20 per acre on the larger farm. After year 15, negative flows became larger, doubling in size by year 22, for both farm sizes. Figures 2 to 5 provide graphic representations of cash flows after financing and total annual outstanding debt for the 960- and 485-acre farms respectively.

During the first four years of the project total investment costs were $340 002 on the 960-acre farm and $225 521 on the 485-acre

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1. Production Economics Branch, Farm Machinery Costs, 1982.

FIG. 2

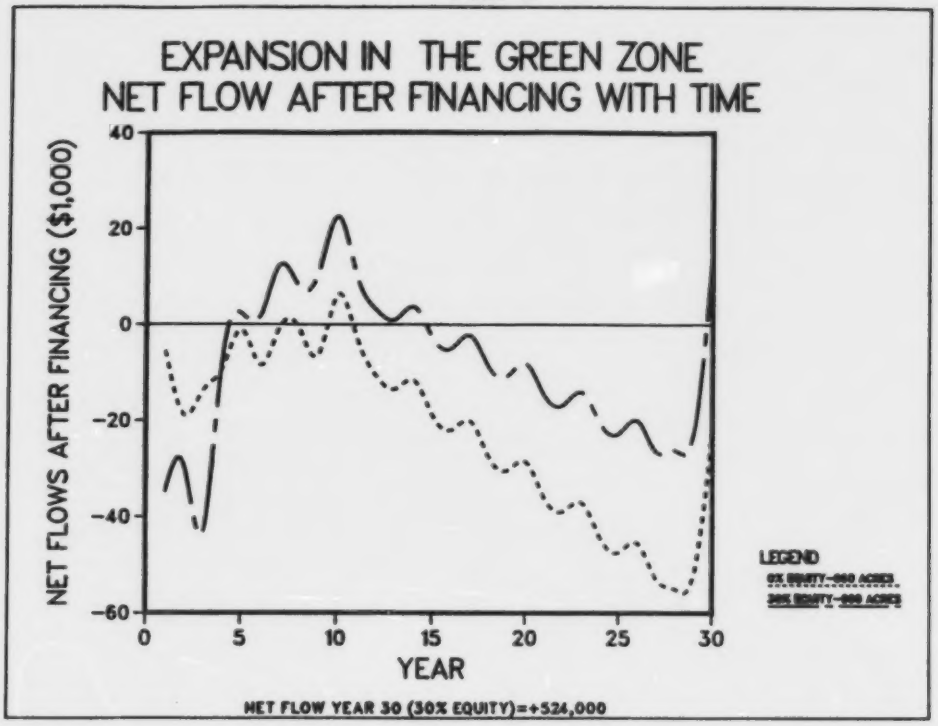

EXPANSION IN THE GREEN ZONE
NET FLOW AFTER FINANCING WITH TIME
NET FLOWS AFTER FINANCING ($1,000)
40
20
0
-20
-40
-60
0
5
10
15
20
25
30
YEAR
LEGEND
NET FLOW YEAR 30 (30% EQUITY)=+524,000

FIG. 3

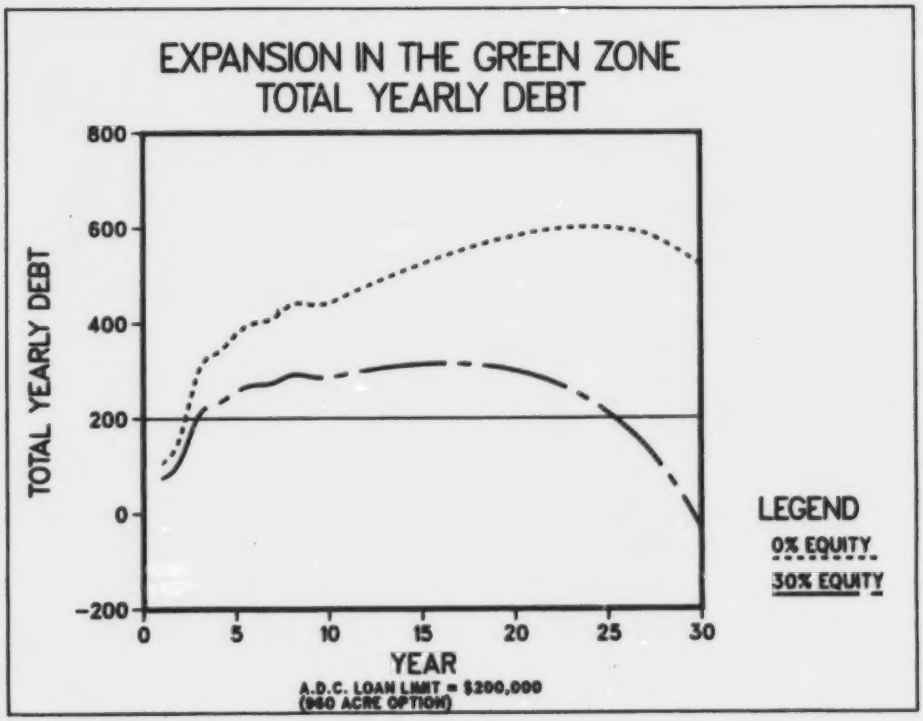

EXPANSION IN THE GREEN ZONE
TOTAL YEARLY DEBT
TOTAL YEARLY DEBT
800
600
400
200
0
-200
0
5
10
15
20
25
30
YEAR
LEGEND
0% EQUITY
30% EQUITY
A.D.C. LOAN LIMIT = $200,000
(960 ACRE OPTION)

FIG. 4

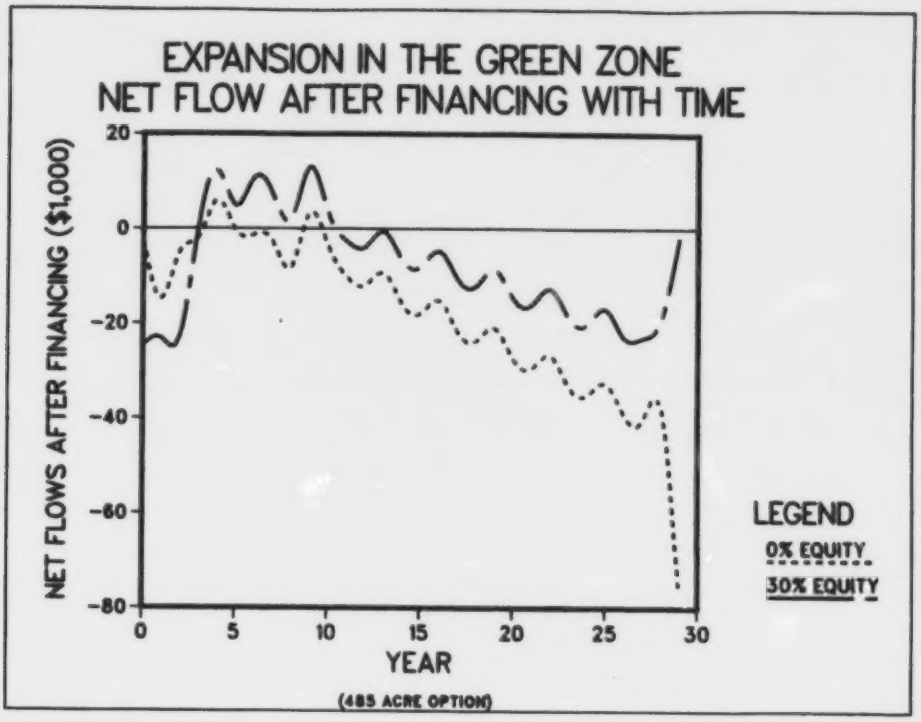
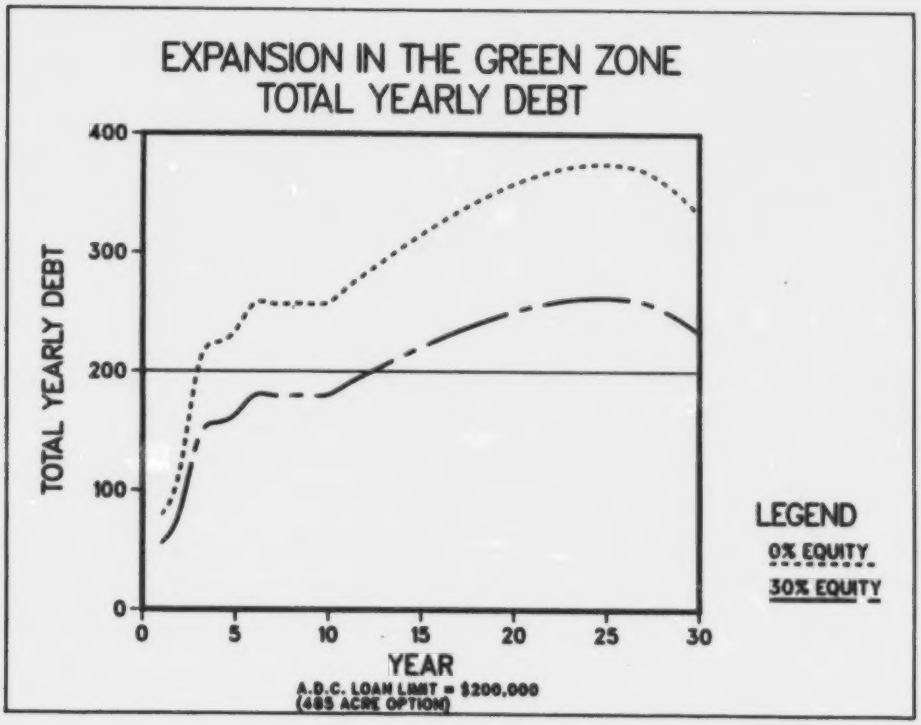

EXPANSION IN THE GREEN ZONE
NET FLOW AFTER FINANCING WITH TIME
NET FLOWS AFTER FINANCING ($1,000)
20
0
-20
-40
-60
-80
0
5
10
15
20
25
30
YEAR
(485 ACRE OPTION)
LEGEND
0% EQUITY
30% EQUITY

FIG. 5


EXPANSION IN THE GREEN ZONE
TOTAL YEARLY DEBT
TOTAL YEARLY DEBT
400
300
200
100
0
0
5
10
15
20
25
30
YEAR
A.D.C. LOAN LIMIT = $200,000
(485 ACRE OPTION)
LEGEND
0% EQUITY
30% EQUITY

farm. Capital repayments totalled only $3 543 and $2 440 respectively, or 1.0 per cent of total loans. By year 10 (on the 960-acre farm) loans had increased to over $450 000 while capital repayments totalled only $19 000. The outstanding debt was still over $400 000.

If no further loans were required, the total debt would plateau and start to decline. While land improvement debt was declining (from $237 000 in year 10 to $158 000 by year 25), the equipment capital debt was increasing (from $204 000 in year 10 to $440 000 in year 25), reflecting an average machinery and equipment replacement cost to $14 000 per annum. By year 25, total debt was almost $600 000; capital repayment was up to $25 000 per annum, and the total debt started to decline. Not until year 27 was the annual capital repayment on equipment greater than the additional annual loans for this item. Finally, in year 30 the total outstanding debt was $473 580. This could be almost completely liquidated by salvage and residual values totalling $468 307.

The salvage and residual values were taken into account in year 30. The changes in flows in year 30 reflect the net effect of liquidating outstanding loans and realizing the salvage and residual values. In all cases, except the 485-acre farm at 0 per cent equity, the salvage and residual values were close to the value of outstanding debt, resulting in the negative flows approaching zero or becoming positive. Income tax payments were zero except in year 30 (tax on the residual value). Therefore, flows were not affected after taxes, other than in year 30.

From Table 10 it is seen that this alternative was only financially feasible at the total resources analysis level, under the base assumptions. The 960-acre case was slightly better than the 485-acre case, the AECF being $4 per acre higher and B/C ratio 0.06 higher. The project did not withstand the financing conditions of the base case. After financing, B/C ratios fell to below 1.0 and AECF's became negative. The larger farm was slightly better than the smaller farm but still not viable. The results after taxes were similar to those before taxes. Results were not substantially changed by the exclusion of the residual land value (see Table 11). However, the exclusion of subsidies reduced net returns by about 50 per cent, making the negative values as much as 50 per cent greater than the case with subsidies (see Table 12).

TABLE 10

FINANCIAL ANALYSIS: GREEN AREA CONVERSION[1]
WITH RESIDUAL VALUE

Case	AECF ($/ac) Total Resources[2]	AECF ($/ac) After Financing	AECF ($/ac) After Fin. & Tax
485 acres	11.84	-26.29	-26.42
960 acres	15.99	-17.50	-17.62

Case	NPV ($/ac) Total Resources	NPV ($/ac) After Financing	NPV ($/ac) After Fin. & Tax
485 acres	181.94	-404.14	-406.20
960 acres	245.83	-268.60	-270.81

Case	B/C (ratio) Total Resources	B/C (ratio) After Financing	B/C (ratio) After Fin. & Tax
485 acres	1.12	0.86	0.86
960 acres	1.18	0.89	0.89

1. Based on a 30-year project, 5 per cent discount rate, 0 equity, and beginning farmer loan.

2. Return to all resources before (without) financing.

TABLE 11

FINANCIAL ANALYSIS: GREEN AREA CONVERSION [1]
NO RESIDUAL VALUE

Case	AECF ($/ac) Total Resources [2]	AECF ($/ac) After Financing	AECF ($/ac) After Fin. & Tax
485 acres	8.12	-30.00	-30.00
960 acres	12.14	-21.30	-21.47

Case	NPV ($/ac) Total Resources	NPV ($/ac) After Financing	NPV ($/ac) After Fin. & Tax
485 acres	124.83	-461.25	-461.25
960 acres	186.63	-327.80	-330.01

Case	B/C (ratio) Total Resources	B/C (ratio) After Financing	B/C (ratio) After Fin. & Tax
485 acres	1.08	0.84	0.84
960 acres	1.14	0.87	0.87

1. Based on a 30-year project, 5 per cent discount rate, 0 equity, and beginning farmer loan.

2. Return to all resources before (without) financing.

TABLE 12

FINANCIAL ANALYSIS: GREEN AREA CONVERSION[1]
WITH RESIDUAL VALUE
WITHOUT SUBSIDIES

Case	AECF ($/ac) Total Resources[2]	AECF ($/ac) After Financing	AECF ($/ac) After Fin. & Tax
485 acres	7.73	-39.03	-39.23
960 acres	11.88	-26.22	-26.42

Case	NPV ($/ac) Total Resources	NPV ($/ac) After Financing	NPV ($/ac) After Fin. & Tax
485 acres	118.76	-599.60	-602.76
960 acres	182.64	-403.10	-406.10

Case	B/C (ratio) Total Resources	B/C (ratio) After Financing	B/C (ratio) After Fin. & Tax
485 acres	1.08	0.79	0.79
960 acres	1.14	0.84	0.83

1. Based on a 30-year project, 5 per cent discount rate, 0 equity, and beginning farmer loan.

2. Return to all resources before (without) financing.

Sensitivity analysis indicated that a substantial increase in the equity level was required to make the after financing cases viable (see Appendix I). At a 30 per cent equity level, the 485-acre case could almost withstand the financing conditions and remain viable, with a B/C ratio of 0.91. The larger 960-acre farm was just marginally viable at the 30 per cent equity level, with a B/C ratio of 1.00. Both farm sizes showed improved cash flows at the 30 per cent equity level. Also, debt size was more reasonable, the maximum outstanding loans being in the vicinity of $300 000 for the 960-acre farm and $250 000 for the 485-acre farm.

2.4 Conclusion

Expansion into new lands in the Green Area is an expensive proposition. Equipment costs must be phased in over a number of years. Used equipment (2-3 years old) is more economical than new equipment. Clearing and farming new lands require a high level of management skills. Drainage and other possible soil problems must be carefully dealt with in order that a viable farm operation may thrive. This study did not deal with specific soil-related problems of new lands; however, the results imply that good management is critical to farm success.

Several scenarios were examined for the expansion alternative. This was done so that the most appropriate farm management system could be chosen for comparison purposes. The scenario chosen was the 960-acre farm under a C/C system. Many farms in the Peace River Area are following a C/C pattern and the larger farm size of 960 acres seems to be more cost effective than the smaller 485-acre farm size.

While both farm sizes were shown to be economically viable, the larger farm was slightly better than the smaller farm. This alternative was shown to be financially viable only at the total resources level (i.e. before financing or with 100 per cent equity). The larger farm would withstand financing of up to 70 per cent (30 per cent equity), but the smaller farm would require a higher equity level. The current subsidies and grants go some way in making development feasible. Without

land improvement grants and crop insurance subsidies, the net financial returns fell significantly by at least 50 per cent.

For the level of on-farm investment required to establish a 960-acre farm, the current $200 000 Beginning Farmer Loan Program appears inadequate. This amount is not even sufficient to establish the smaller, less viable farm (485 acres). If additional funds are available at commercial bank rates, then the interest payments are too great relative to farm income, and capital repayment is not achieved in the 30 years considered. This situation is borne out by the fact that new farms can only be established with partial equity financing or through off-farm income during the first 10, 20 or 30 years of operation. Debt of 70 per cent or more on a $300 000 or $600 000 investment cannot be supported from farm income. In fact, at 30 per cent equity level, returns to equity, land, labour and management are so minimal that off-farm income is also essential for family living expenses.

Development of frontier agriculture has always been greatly dependent on off-farm income because of high initial costs and low returns for the first several years. The results of this study confirm that this situation still prevails. Relatively high equity and off-farm income are prerequisites for success, with the farmer sharing the risk of this type of investment. It is operators with well above average management ability who will succeed, while those with lesser managerial ability will probably fail.

3. IRRIGATION EXPANSION[1]

3.1 Objectives

(i)To determine the economic feasibility of irrigation intensification and expansion in irrigation climatic zones A1, A2, B and C (see Figure 6).

(ii)To evaluate the financial feasibility of the intensification and expansion of irrigation in the five irrigation climatic zones of southern Alberta.

3.2 Methodology and Assumptions

3.2.1 Economic Analysis

To determine the on-farm economic benefits and costs of irrigation intensification and expansion, the following methods and assumptions were used:

(i)The methodology described and assumptions given in the Introduction apply to this study, except where otherwise stated.

(ii)The analysis focused on two basic scenarios: intensification/ extension of existing irrigation districts and private irrigation developments; and expansion into "new" areas. Eight base cases were examined; these are given in Table 13.

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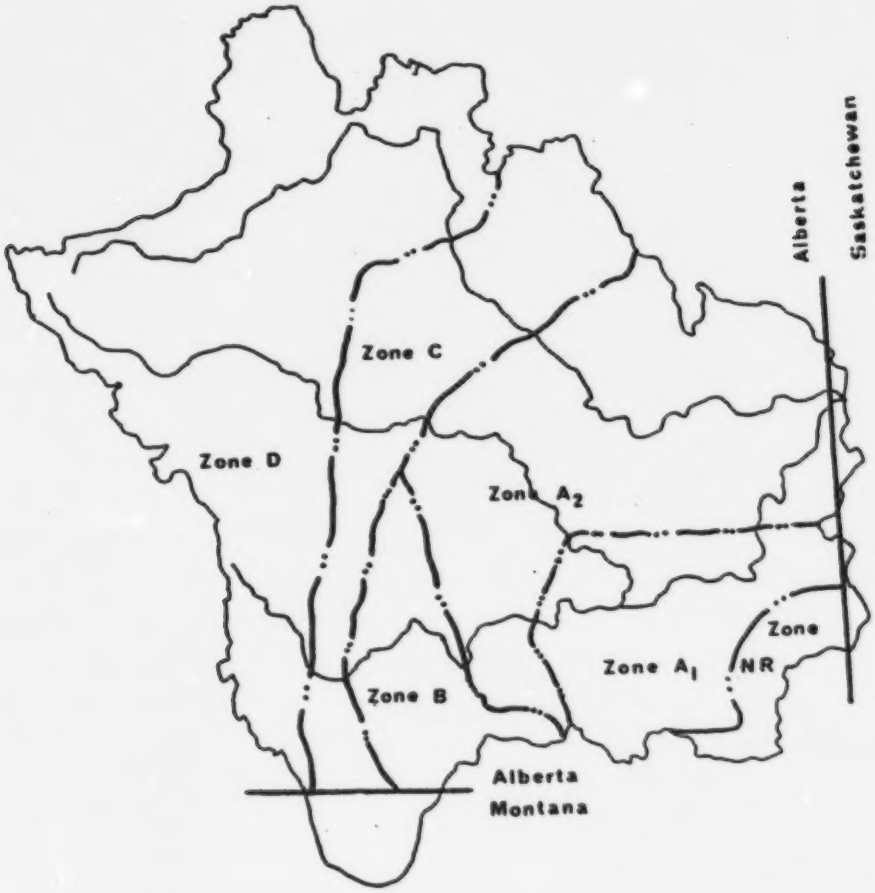
1. This chapter was derived in part from a study by Alan Dooley of Marv Anderson & Associates Limited for Alberta Agriculture. Modifications were made to the analysis to be consistent with other alternatives. Additional analysis was done for Zone C Int./Ext. The financial analysis was done entirely by the Production and Resource Economics Branch, Alberta Agriculture.

FIG. 6

SOUTH SASKATCHEWAN RIVER BASIN IRRIGATION CLIMATIC ZONES



Zone	Characteristics
A1	> 1650 Heat Units (5°C) > 140 Day Growing Season (-2°C) 250-300 mm Moisture Deficit
A2	1350-1650 Heat Units (5°C) 120-140 Day Growing Season (-2°C) 250-300 mm Moisture Deficit
B	1350-1650 Heat Units (5°C) 120-140 Day Growing Season (-2°C) 200-250 mm Moisture Deficit

Zone	Characteristics
C	1150-1350 Heat Units (5°C) 120-140 Day Growing Season 150-250 mm Moisture Deficit
D	< 1200 Heat Units (5°C) < 120 Day Growing Season < 150 mm Moisture Deficit
NR	Not Rated

Source: Van Deurzen, A.G.N. and A.L. Birch (1983), Irrigation Water Requirements in the South Saskatchewan River Basin: Economic Component, Economic Services Division, Alberta Agriculture.

TABLE 13

DEVELOPMENT ALTERNATIVES BY IRRIGATION CLIMATIC ZONE

Irrigation Climatic Zone	Corresponding Soil Zone	Development Alternative
A1	Brown	Int./Ext. and Expansion
A2	Brown/Dark Brown	Int./Ext. and Expansion
B	Dark Brown	Int./Ext. and Expansion
C	Dark Brown	Int./Ext. and Expansion

(iii) On-farm adoption for the intensification/extension scenario was assumed to take place according to the schedule given in Table 14. On-farm adoption rates for the expansion scenario were assumed to occur one-half as fast as for the intensification/extension scenario (i.e. over a 20-year period). The costs for expansion were therefore spread over a longer period.

TABLE 14

ON-FARM ADOPTION SCHEDULE FOR INTENSIFICATION/EXTENSION

Year	% of Potential
1	--
2	--
3	30
4	40
5	50
6	60
7	70
8	80
9	90
10	100

(iv) Increases in irrigated area were based on 50 per cent wheel roll systems (4 laterals per quarter section, 12 hour sets) and 50 per cent stationary centre pivots (¼ mile long, 70 p.s.i. at the pivot). Both systems were assumed to be powered by natural gas. Capital costs of these two sprinkler systems were $309 per acre for wheel roll and $512 per acre for centre pivot.[1]

(v) All sprinklers, motors and pumps had a life expectancy of 15 years. The PVC pipe (for the centre pivot system) had a life span of fifty years and an estimated capital cost amounting to about 13.5 per cent of total centre pivot capital cost.[2]

(vi) Other on-farm capital costs included the cost of dugouts. These had an estimated life expectancy of 50 years and cost about $5 000 each ($31.25 per acre for all wheel roll systems; $37.88 per acre for the pivot system).

(vii) Annual operation and maintenance costs for 14.4" (36/6 cm) of water applied were estimated as shown in Table 15. These costs were included in production costs and are not included in the irrigation investment cost stream.

(viii) The crop mix used in the analysis is provided in Table 16.

---

1. Cost data for 1983 were provided courtesy of Len Ring, Alberta Agriculture, Lethbridge, Alberta. All items deflated using CPI (deflation factor = .945).

2. Marv Anderson & Associates Limited., An Economic Study of Alternative Irrigation Systems, Albion Ridge Irrigation Block, prepared for Alberta Agriculture, Edmonton, 1981, p. 2.11.

TABLE 15

ANNUAL OPERATION AND MAINTENANCE COSTS[1]

Cost Item	Wheel Roll	Centre Pivot
	($/ac)	
Labour	5.10	2.40
Maintenance & Repairs	4.90	8.40
Energy (natural gas)	13.15	15.00
Total	23.15	25.80

1. The basic data on which these estimates were based used 12" (30.5 cm) of water applied. For the purpose of this study, operating and maintenance costs were assumed to be linear. Thus, the data were increased by a factor of 1.2 (i.e. 36.6/30.5 = 1.2).

TABLE 16

IRRIGATED CROP MIX DATA BY IRRIGATION CLIMATIC ZONE[1]

Irrigation Climatic Zone	Crop Mix[2]						
	Wheat	Alfalfa	Barley	Sugar Beets	Oilseeds	Pasture	Other
	(%)						
Zone A1	41	14	14	6	6	5	14
Zone A2	28	22	24	4	3	6	13
Zone B	21	28	26	3	2	6	14
Zone C	8	33	21	-	4	27	7

1. Source: Alberta Agriculture, Economic Services Division, Lethbridge.
2. Represents percentage of cropped area.

(ix)With minor changes, annual cost of production estimates for dryland farming and revenue estimates for dryland and irrigated farming by irrigation climatic zone were extracted from the South Saskatchewan River Basin Planning Program study.[1] Irrigated crop production costs were derived from the South Saskatchewan River Basin, Economic Component.[2]

(x)From the basic cost and revenue data, annual net returns from converting dryland to irrigated crop production were calculated and summarized in Table 17.

(xi)As with other alternatives, no residual value was included in the base case.

TABLE 17

ANNUAL NET RETURNS TO IRRIGATED CROP PRODUCTION

Irrigation Climatic Zone	Dryland Revenue	Dryland Costs	Irrigated Revenue	Irrigated Costs	Total Income Change
	($/ac.)				
A1	34.22	16.59	455.23	153.47	284.23
A2	36.70	16.68	358.32	132.71	205.59
B	56.03	27.55	331.91	128.51	174.93
C	54.69	25.80	251.73	103.69	119.15

1. Strong-Hall & Associates, Marv Anderson & Associates Limited, and Environmental Management Associates, South Saskatchewan River Basin Planning Program Evaluation Methodologies and Data Base, Alberta Environment, Calgary, July 1983.

2. Alberta Agriculture, Irrigation Water Requirements in the South Saskatchewan River Basin: Economic Component, Edmonton, Feb. 1983.

(xii) Sensitivity analyses were performed on certain variables as follows:

a] Discount rates 3 per cent and 7 per cent;

b] System costs ± 20 per cent;

c] Crop benefits - 20 per cent;

d] Incremental costs ± 10 per cent; and

e] Inclusion of a residual land value.

3.2.2 Financial Analysis

To determine whether farmers have sufficient incentive and suitably timed cash flows to make the investment in irrigation, the following transfer payments were evaluated:

Inflows

(i) A water development grant from the Prairie Farm Rehabilitation Association (P.F.R.A.) was taken into account. This grant reimburses farmers for one third of the eligible costs of irrigation projects to a maximum of $2 200 per project.

(ii) The total area of 10 000 acres, which was considered in this alternative as the improved area, was assumed to be owned by 10 producers. This permitted the evaluation of 10 projects and thus 10 times the maximum grant per project.

(iii) Crop insurance and Western Grain Stabilization (WGS) benefits were as stated in the Introduction.

(iv) It was assumed that for any capital investment, the level of equity was 0, that is, the investments required by these projects were financed totally by loans.

(v) Salvage value was based on the undepreciated portion of the sprinklers and dugout at either replacement time or at the end of the project (year 30).

(vi) The residual value attributed to the land was based on the increased market value of the land resulting from irrigation, adjusted for

the salvage value of the irrigation equipment. Sensitivity was done with no residual value. Sensitivity was also done with a residual value and an irrigated land purchase cost equivalent to the residual value.[1]

(vii) Sensitivity analysis was done excluding crop insurance subsidies and water development grants.

Outflows

(viii) The interest rate used for loans was 13 per cent, with a repayment period of 10 years.

(ix) The initial capital cost for the water right was charged in the first year of the project.

(x) Assumptions related to operating capital, crop insurance and WGS payments and marginal tax rates were as stated in the Introduction.

(xi) Capital cost allowance for tax purposes was calculated using a declining balance, at a rate of 10 per cent for sprinkler systems and a rate of 5 per cent for dugouts.[2]

3.3 Results

3.3.1 Economic Analysis

Results indicated that all development alternatives considered would be viable from an on-farm perspective. A summary of the results is

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1. While this increased land value results partly from off-farm investments, the benefit accrues to the farmer. It can be argued that this benefit would be captured with or without investment in irrigation equipment, and would be a cost to a new irrigation farmer.

2. Revenue Canada, Farmer's Income Tax Guide, 1982.

provided in Table 18. The discounted investment cost for sprinklers and dugouts was $476 per acre for intensification and $367 for expansion (reflecting different adoption rates and amount of discounting). In irrigation climatic zones A1 and A2 AECF's were between $87 and $178 per acre and B/C ratios 2.0 to 2.3. Results were lower in zones B and C, the AECF's being between $41 and $98 per acre and B/C ratios 1.6 to 1.9. IRR's were over 50 per cent in all cases.

Even when subjected to more adverse economic conditions than assumed for the base case, all development alternatives were shown to be economically feasible. B/C ratios remained above 1.8 for zone A1 and above 1.5 for zones A2 and B, when a discount rate of 7 per cent was used or when costs increased by 20 per cent or benefits decreased by 20 per cent. Effects were even smaller with a 10 per cent increase in incremental production costs. Inclusion of a residual value for land increased the AECF's and B/C ratios substantially. Details are given in Appendix II.

TABLE 18

ECONOMIC PERFORMANCE MEASURES FOR IRRIGATION[1]

	DIC[2]	NPV	AECF	B/C
	--------($/acre)-------			(ratio)
Intensification/Extension				
Zone A1	476	2 739	178	2.35
Zone A2	476	1 850	120	2.03
Zone B	476	1 503	98	1.93
Zone C	476	872	57	1.64
Expansion				
Zone A1	367	1 998	130	2.33
Zone A2	367	1 344	87	2.01
Zone B	367	1 089	71	1.90
Zone C	367	625	41	1.62

1. Based on a discount rate of 5 per cent and on 10 000 acre blocks.

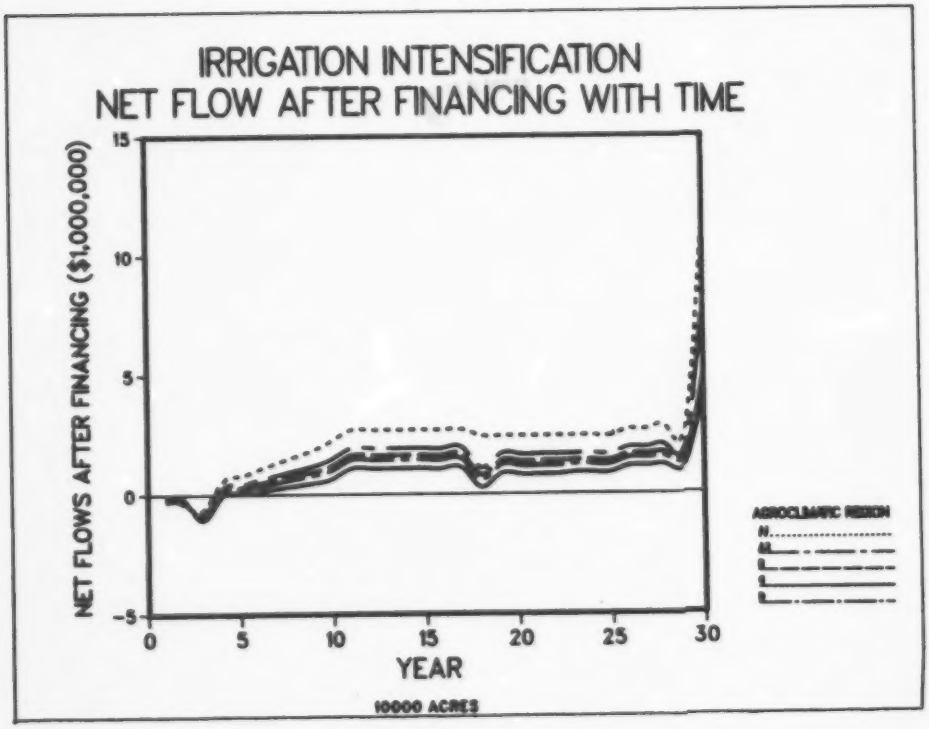
2. Intensification costs spread over 10 years; expansion over 20 years. The former costs were therefore discounted to a lesser extent; hence their higher value.

3.3.2 Financial Analysis

Irrigation Intensification

Analysis was done at three levels: to all resources before financing, to the farmer's resources after financing; and to the farmer's resources after financing and taxes. Total undiscounted negative flows, in the order of $12.50 to $107 per acre ($12 500 to $107 000 per 1 000 acre unit), were experienced before financing during the first three years of the investment. After financing, these fell to between $12.50 and $41 per acre, in the first two years of the investment only. The stream of net cash flows after financing are provided in Figure 7. After taxes, the negative values were further reduced to between $12.50 and $33 per acre. Costs in the first year represented the charge for the water right. Those in year two represented incremental operating capital for year three.

FIG. 7



Intensifying irrigation would be financially feasible in all the irrigation climatic zones examined. All zones had positive NPV's and AECF's and B/C ratios greater than one. Results presented in Table 19 indicate that irrigation climatic zone A1 had the highest values and zone C the lowest. The ranking of the zones was not affected by the level of analysis, whether done before or after financing or after taxes. In all zones, the returns to all resources (before financing) were about $14 (or 9 to 27 per cent) higher than those after financing and about $22 to $45 (26 to 43 per cent) higher than those after financing and taxes, depending on the soil zone. All projects withstood the financing and tax assumptions used.

Removal of a residual value for land reduced the B/C ratio by 0.06 and the AECF by $8 per acre (5 per cent) in zone A1, but did not affect the feasibility of irrigation (Table 20). The addition of a cost for irrigated land (with a residual value included) had a greater impact. The B/C ratio was reduced by 0.39 and the AECF by $35 per acre (20 per cent) in zone A1 (Table 21). The impact was slightly smaller in zone A2 and substantially smaller in the other zones. This last observation reflects the less significant difference between irrigated and dryland values in zones B, C and D than in zones A1 and A2. The exclusion of subsidies and grants reduced net returns by less than 10 per cent in zones A1, A2 and B and by 12 and 20 per cent in zones D and C respectively (see Table 22).

From the sensitivity analysis tables presented in Appendix II it is seen that zone A1 remained financially feasible up to a discount rate of 50 per cent (before and after financing). This indicates that the IRR is greater than 50 per cent. All zones were found to be feasible at a discount rate of 10 per cent at each level of analysis. By increasing the tax rate from 20 per cent to 30 per cent (at a discount rate of 5 per cent), all cases were still feasible, the AECF's after financing and taxes having only decreased by 10 to 14 per cent, depending on the zone.

TABLE 19

FINANCIAL ANALYSIS: IRRIGATION INTENSIFICATION BY IRRIGATION CLIMATIC ZONE[1] WITH RESIDUAL VALUE

	B/C Ratio	AECF ($/ac)	NPV ($/ac)
Zone A1			
Before Financing	2.13	175.26	2 694.17
After Financing	1.80	160.92	2 473.68
After Fin. & Tax (20%)	1.56	129.32	1 987.96
Tax Rate (30%)	1.46	113.52	1 745.10
Zone A2			
Before Financing	1.85	117.10	1 800.06
After Financing	1.56	102.75	1 579.58
After Fin. & Tax (20%)	1.41	82.31	1 265.33
Tax Rate (30%)	1.34	72.09	1 108.21
Zone B			
Before Financing	1.77	93.96	1 444.35
After Financing	1.47	79.61	1 223.87
After Fin. & Tax (20%)	1.35	63.54	976.75
Tax Rate (30%)	1.29	55.50	853.19
Zone C			
Before Financing	1.56	57.00	876.23
After Financing	1.29	42.66	655.75
After Fin. & Tax (20%)	1.22	34.02	522.94
Tax Rate (30%)	1.19	29.70	456.53
Zone D			
Before Financing	1.81	82.40	1 266.77
After Financing	1.46	68.06	1 046.28
After Fin. & Tax (20%)	1.34	54.34	835.37
Tax Rate (30%)	1.28	47.48	729.91

1. Discount rate of 5 per cent.

TABLE 20

FINANCIAL ANALYSIS: IRRIGATION INTENSIFICATION BY IRRIGATION CLIMATIC ZONE [1] NO RESIDUAL VALUE

	B/C Ratio	AECF ($/ac)	NPV ($/ac)
Zone A1			
Before Financing	2.07	166.85	2 564.85
After Financing	1.76	152.50	2 344.36
After Fin. & Tax (20%)	1.53	121.75	1 871.57
Tax Rate (30%)	1.43	106.37	1 635.17
Zone A2			
Before Financing	1.82	112.11	1 723.47
After Financing	1.54	97.77	1 502.99
After Fin. & Tax (20%)	1.38	77.83	1 196.40
Tax Rate (30%)	1.32	67.86	1 043.11
Zone B			
Before Financing	1.76	93.09	1 431.02
After Financing	1.47	78.75	1 210.54
After Fin. & Tax (20%)	1.34	62.76	964.75
Tax Rate (30%)	1.29	54.76	841.85
Zone C			
Before Financing	1.55	55.98	860.62
After Financing	1.28	41.64	640.14
After Fin. & Tax (20%)	1.21	33.10	508.89
Tax Rate (30%)	1.18	28.84	443.27
Zone D			
Before Financing	1.80	81.39	1 251.16
After Financing	1.46	67.05	1 030.67
After Fin. & Tax (20%)	1.33	53.43	821.32
Tax Rate (30%)	1.28	46.62	716.64

1. Discount rate of 5 per cent.

TABLE 21

FINANCIAL ANALYSIS: IRRIGATION INTENSIFICATION BY IRRIGATION CLIMATIC ZONE [1] WITH LAND COST AND RESIDUAL VALUE

	B/C Ratio	AECF ($/ac)	NPV ($/ac)
Zone A1			
Before Financing	1.74	140.63	2 161.87
After Financing	1.54	126.29	1 941.38
After Fin. & Tax (20%)	1.36	95.53	1 468.59
Tax Rate (30%)	1.28	80.16	1 232.19
Zone A2			
Before Financing	1.61	96.59	1 484.82
After Financing	1.40	82.25	1 264.33
After Fin. & Tax (20%)	1.28	62.30	957.74
Tax Rate (30%)	1.22	52.33	804.45
Zone B			
Before Financing	1.72	90.39	1 389.47
After Financing	1.44	76.04	1 168.99
After Fin. & Tax (20%)	1.32	60.06	923.20
Tax Rate (30%)	1.27	52.06	800.31
Zone C			
Before Financing	1.50	52.82	811.98
After Financing	1.25	38.48	591.50
After Fin. & Tax (20%)	1.19	29.94	460.25
Tax Rate (30%)	1.16	25.67	394.63
Zone D			
Before Financing	1.74	78.23	1 202.52
After Financing	1.42	63.88	982.04
After Fin. & Tax (20%)	1.31	50.26	772.68
Tax Rate (30%)	1.25	43.45	668.00

1. Discount rate of 5 per cent.

TABLE 22

FINANCIAL ANALYSIS: IRRIGATION INTENSIFICATION BY IRRIGATION CLIMATIC ZONE[1] WITH RESIDUAL VALUE WITHOUT SUBSIDIES

	B/C Ratio	AECF ($/ac)	NPV ($/ac)
Zone A1			
Before Financing	2.12	170.80	2 625.67
After Financing	1.79	156.46	2 405.19
After Fin. & Tax (20%)	1.55	125.75	1 933.16
Tax Rate (30%)	1.45	110.40	1 697.15
Zone A2			
Before Financing	1.83	112.01	1 721.88
After Financing	1.54	97.67	1 501.39
After Fin. & Tax (20%)	1.39	78.24	1 202.78
Tax Rate (30%)	1.33	68.53	1 053.48
Zone B			
Before Financing	1.73	88.18	1 355.57
After Financing	1.45	73.84	1 135.09
After Fin. & Tax (20%)	1.33	58.92	905.72
Tax Rate (30%)	1.27	51.46	791.04
Zone C			
Before Financing	1.43	45.56	700.39
After Financing	1.21	31.22	479.91
After Fin. & Tax (20%)	1.15	24.13	370.98
Tax Rate (30%)	1.13	20.59	316.51
Zone D			
Before Financing	1.76	75.86	1 166.20
After Financing	1.42	61.52	945.71
After Fin. & Tax (20%)	1.31	49.11	754.91
Tax Rate (30%)	1.26	42.90	659.51

1. Discount rate of 5 per cent.

Irrigation Expansion

Negative flows were approximately half the value of those for intensification, reflecting the more gradual phasing in of the irrigation investment (see Figure 8). As was the case with irrigation intensification, zone A1 showed the best financial feasibility, zone C keeping the last position (see Table 23). B/C ratios were almost identical, but AECF's were all below those of intensification. Removal of a residual value did not affect feasibility but reduced all values (see Table 24). Inclusion of an irrigated land cost, with a residual value, had a similar impact to that in the intensification case (see Table 25). The effect of removing subsidies and grants was identical to the effect on returns from intensification (see Table 26). Changes in the discount rate produced the same impact as for irrigation intensification (see Appendix II). The sensitivity analysis showed that a change in tax rate produced a decrease in the AECF's of approximately 13 per cent (at a discount rate of 5 per cent), but all cases remained feasible.

FIG. 8

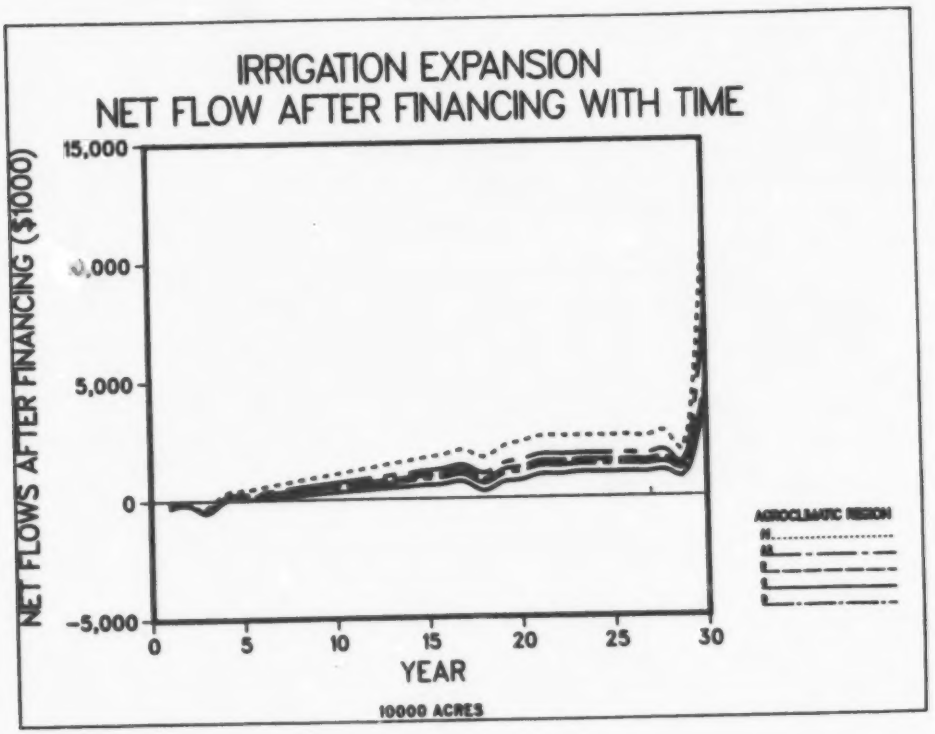


TABLE 23

FINANCIAL ANALYSIS: IRRIGATION EXPANSION BY IRRIGATION CLIMATIC ZONE [1]
WITH RESIDUAL VALUE

	B/C Ratio	AECF ($/ac)	NPV ($/ac)
Zone A1			
Before Financing	2.13	131.28	2 018.12
After Financing	1.81	121.47	1 867.30
After Fin. & Tax (20%)	1.57	97.90	1 504.92
Tax Rate (30%)	1.47	86.11	1 323.74
Zone A2			
Before Financing	1.85	87.42	1 343.83
After Financing	1.57	77.61	1 193.00
After Fin. & Tax (20%)	1.41	62.33	958.15
Tax Rate (30%)	1.34	54.69	840.72
Zone B			
Before Financing	1.76	69.51	1 068.53
After Financing	1.48	59.70	917.71
After Fin. & Tax (20%)	1.35	47.74	733.90
Tax Rate (30%)	1.29	41.76	641.99
Zone C			
Before Financing	1.56	42.41	651.89
After Financing	1.30	32.60	501.07
After Fin. & Tax (20%)	1.22	26.10	401.27
Tax Rate (30%)	1.19	22.86	351.38
Zone D			
Before Financing	1.81	61.09	939.13
After Financing	1.47	51.28	788.31
After Fin. & Tax (20%)	1.34	41.05	631.06
Tax Rate (30%)	1.29	35.94	552.44

1. Discount rate of 5 per cent.

TABLE 24

FINANCIAL ANALYSIS: IRRIGATION EXPANSION BY IRRIGATION CLIMATIC ZONE [1]
NO RESIDUAL VALUE

	B/C Ratio	AECF ($/ac)	NPV ($/ac)
Zone A1			
Before Financing	2.06	123.18	1 893.61
After Financing	1.76	113.37	1 742.79
After Fin. & Tax (20%)	1.53	90.61	1 392.87
Tax Rate (30%)	1.43	79.23	1 217.91
Zone A2			
Before Financing	1.81	82.75	1 272.06
After Financing	1.54	72.94	1 121.23
After Fin. & Tax (20%)	1.38	58.13	893.55
Tax Rate (30%)	1.32	50.72	779.72
Zone B			
Before Financing	1.75	68.96	1 060.01
After Financing	1.47	59.14	909.19
After Fin. & Tax (20%)	1.34	47.24	726.23
Tax Rate (30%)	1.29	41.29	634.75
Zone C			
Before Financing	1.55	41.70	641.10
After Financing	1.29	31.89	490.28
After Fin. & Tax (20%)	1.22	25.47	391.56
Tax Rate (30%)	1.19	22.26	342.20
Zone D			
Before Financing	1.80	60.39	928.34
After Financing	1.46	50.58	777.51
After Fin. & Tax (20%)	1.34	40.42	621.35
Tax Rate (30%)	1.28	35.34	543.27

1. Discount rate of 5 per cent.

TABLE 25

FINANCIAL ANALYSIS: IRRIGATION EXPANSION BY IRRIGATION CLIMATIC ZONE [1]
WITH LAND COST AND RESIDUAL VALUE

	B/C Ratio	AECF ($/ac)	NPV ($/ac)
Zone A1			
Before Financing	1.66	97.94	1 505.63
After Financing	1.48	88.13	1 354.81
After Fin. & Tax (20%)	1.32	65.37	1 004.89
Tax Rate (30%)	1.25	53.99	829.93
Zone A2			
Before Financing	1.56	68.20	1 048.40
After Financing	1.38	58.39	897.58
After Fin. & Tax (20%)	1.26	43.58	669.90
Tax Rate (30%)	1.20	36.17	556.06
Zone B			
Before Financing	1.72	67.23	1 033.47
After Financing	1.45	57.42	882.64
After Fin. & Tax (20%)	1.33	45.52	699.68
Tax Rate (30%)	1.27	39.56	608.21
Zone C			
Before Financing	1.50	39.52	607.47
After Financing	1.26	29.71	456.64
After Fin. & Tax (20%)	1.20	23.28	357.93
Tax Rate (30%)	1.16	20.07	308.57
Zone D			
Before Financing	1.74	58.20	894.70
After Financing	1.43	48.39	743.88
After Fin. & Tax (20%)	1.31	38.23	587.72
Tax Rate (30%)	1.26	33.15	509.63

1. Discount rate of 5 per cent.

TABLE 26

FINANCIAL ANALYSIS: IRRIGATION EXPANSION BY IRRIGATION CLIMATIC ZONE [1]
WITH RESIDUAL VALUE
WITHOUT SUBSIDIES

	B/C Ratio	AECF ($/ac)	NPV ($/ac)
Zone A1			
Before Financing	2.12	126.98	1 952.06
After Financing	1.80	117.17	1 801.23
After Fin. & Tax (20%)	1.56	94.46	1 452.08
Tax Rate (30%)	1.46	83.10	1 277.50
Zone A2			
Before Financing	1.82	82.66	1 270.64
After Financing	1.54	72.85	1 119.82
After Fin. & Tax (20%)	1.39	58.52	899.60
Tax Rate (30%)	1.33	51.36	789.49
Zone B			
Before Financing	1.72	64.24	987.55
After Financing	1.44	54.43	836.73
After Fin. & Tax (20%)	1.32	43.53	669.12
Tax Rate (30%)	1.27	38.08	585.31
Zone C			
Before Financing	1.48	36.05	554.14
After Financing	1.24	26.24	403.31
After Fin. & Tax (20%)	1.18	21.02	323.07
Tax Rate (30%)	1.16	18.41	282.95
Zone D			
Before Financing	1.74	55.26	849.48
After Financing	1.42	45.45	698.66
After Fin. & Tax (20%)	1.31	36.39	559.35
Tax Rate (30%)	1.26	31.85	489.69

1. Discount rate of 5 per cent.

3.4 Conclusion

The findings suggest that within this alternative, intensification/extension in irrigation climatic zone A1 would give the highest return, with an economic B/C ratio of 2.35 and AECF of $178 per acre, followed by expansion in irrigation climatic zone A1 with a B/C ratio of 2.33 and AECF of $130 per acre. Returns reduced from zone A1, through A2 and B, with zone C having the lowest values. Irrigation climatic zone A1 is in the dry southeastern portion of the province, and consequently the potential increase in yields from irrigation would be greater than for more moderate irrigation climatic zones. Despite the slower adoption rates assumed for the expansion scenario, the results did not differ much from the intensification/extension scenario. This management alternative had a high investment cost of over $300 per acre in terms of present value. The comparison of zones by financial analysis was similar to that of the economic analysis. All financial values were lower than economic values, reflecting mainly the interest costs. Before financing, B/C ratios fell slightly to 2.13 and AECF's to $175 per acre for intensification in irrigation climatic zone A1. After financing, these values fell further to 1.80 and $160 per acre, and still further, after taxes, to 1.56 and $129 per acre respectively. All projects remained financially feasible at each level of analysis. Removal of the residual value, or addition of a land purchase cost reduced all values but did not affect the feasibility of irrigation. Exclusion of subsidies reduced net returns by 10 to 20 per cent.

The nature of this analysis assumed that increased revenues from irrigation did not start to accrue until year three. Nevertheless, there were costs related to water rights and incremental operating capital in years one and two respectively. These resulted in negative cash flows both before and after financing, in the first two years of the project. These would have to be financed through savings, existing revenue from dryland farming or through short-term credit. Results for economic and financial analysis are quite similar, suggesting that transfer payments to and from the farmer (excluding infrastructure costs) are fairly well balanced. After financing, there were no negative flows from year three, indicating that increased revenues and financing conditions were sufficient to facilitate the investment in irrigation equipment.

4. DRAINAGE[1]

4.1 Objectives

(i)To determine the economic feasibility of drainage of wetlands on existing farm land in the Peace, Athabasca, Beaver, North Saskatchewan and Battle River Basins (see Figure 9).

(ii)To evaluate the financial feasibility of drainage of these wetlands of northern Alberta.

4.2 Methodology and Assumptions

4.2.1 Economic Analysis

To determine the on-farm economic benefits and costs of drainage the following methods and assumptions were used:

(i)The methodology described and assumptions given in the Introduction apply to this study, except where otherwise stated.

(ii)All on-farm data were gathered on the basis of sub-basins. The five sub-basins which were studied are: Silver Creek, Lalby Creek, Teepee Creek, Dunvegan Creek and Shoal Creek. The position of each sub-basin in relation to the study area is illustrated in Figure 9. It was assumed that these sub-basins were representative of the different situations which may be found in the study area. A linear programming model was used to obtain the best mix of sub-basins for each major basin. The mix of each major basin is provided in Table 27.

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1. This chapter was derived in part from studies by L.A. Leskiw of Pedology Consultants, and Marv Anderson of Marv Anderson & Associates Limited for the "Inventory of Alberta's Drainage Requirements" commissioned by the Alberta Water Resources Commission. Modifications were made to the analysis to be consistent with other alternatives. Aggregation was done entirely through a methodology developed by the Production and Resource Economics Branch, Alberta Agriculture.

FIG. 9

NORTHERN ALBERTA RIVER BASINS:
Agricultural Areas

LEGEND

Study Area

Non-Agricultural Areas

Agricultural Areas of Southern River Basins

SUB-BASINS

① Dunvegan
② Teepee
③ Lalby
④ Shoal
⑤ Silver

TABLE 27

WEIGHTS FOR CONVERSION FROM SUB-BASIN TO RIVER BASIN

Sub-Basin	Peace	Athabasca	Beaver	N.Sask	Battle
Silver	0.000	0.000	0.000	0.764	1.000
Lalby	0.000	0.057	0.000	0.000	0.000
Teepee	0.229	0.071	0.000	0.035	0.000
Dunvegan	0.176	0.000	0.000	0.000	0.000
Shoal	0.594	0.872	1.000	0.201	0.000
Totals	1.000	1.000	1.000	1.000	1.000

(iii)The analysis focused on partial drainage (Scenario 2) or the drainage of temporary water bodies. Full drainage (Scenario 1) was also examined as a sensitivity. A 30-year project life was used for both options.

(iv)On-farm drainage was assumed to take place in year one of the project and between 10 per cent and 60 per cent of benefits from increased production started accruing from year three, as did benefits due to increased efficiency in farm operations. Auxiliary benefits on lands adjacent to the drained area were obtained from year two. Annual incremental gains were calculated for each of the 30 years of the project. Changes in crop revenues, auxiliary benefits and changes in costs for year seven are provided in Table 28.

(v)Drainage and land preparation costs accrued from year one to three in each mini-basin. Drainage costs ranged from $86 per acre for Teepee to $521 per acre for Silver, while land preparation costs ranged from $12 per acre for Teepee to $157 per acre for Shoal. These costs are shown in Table 29. Sub-surface drainage was the major component of total investment costs, making up between 71 per cent to 85 per cent of the total in each sub-basin.

TABLE 28

ECONOMIC ANALYSIS: BENEFITS AND COSTS OF DRAINAGE[1]

Sub-Basin	Change In Revenue	Auxiliary Benefits	Cost Decreases[2]	Increase In Costs[3]	Net Revenue Change
	($/acre)				
Silver	92.19	58.74	18.64	37.87	131.70
Lalby	92.14	24.24	9.18	32.20	93.36
Teepee	92.10	7.62	8.04	32.18	75.58
Dunvegan	89.52	29.50	10.75	35.00	94.77
Shoal	92.55	3.50	12.04	32.50	75.59

1. Derived from Pedology Consultants and Anderson reports (Scenario 2).

2. Only considers cost decreases in areas other than the wetland.

3. Considers change in costs of production on wet areas.

TABLE 29

DRAINAGE AND LAND PREPARATION COSTS BY SUB-BASIN[1]

Sub-Basin	Drainage Costs	Land Preparation Costs	Total Investment Costs	Drainage O & M Costs
	($/acre)			
Silver	521	104	625	14.10
Lalby	125	26	151	3.30
Teepee	86	12	98	2.40
Dunvegan	276	80	356	6.70
Shoal	380	157	537	13.10

1. Derived from the Pedology Consultants and Anderson reports. (Scenario 2).

(vi)Annual drainage operating costs accrued from year two of each project.

(vii)No residual value was included in the base case.

(viii)Sensitivity analysis was performed on certain variables as follows:

a] Acreage drained-full drainage of all wetlands;

b] Discount rates 3 per cent, 7 per cent and 10 per cent;

c] Crop benefits -20 per cent;

d] Incremental costs +20 per cent; and

e] Inclusion of a residual land value.

4.2.2 Financial Analysis

To determine whether farmers have sufficient incentive and suitably timed cash flows to make the investment in drainage the following transfer payments were evaluated:

Inflows

(i)Farmers installing drainage are eligible for an Alberta Farm Development Loan (AFDL) and a loan incentive under the Range and Soil Improvement Program. The loan for drainage installation was shown as an inflow in year one and for the first five years a rebate of $700 per year was assumed.

(ii)Equity was assumed to be zero on any capital investment, all investment was financed through borrowing.

(iii)Crop insurance claims were assumed to be twice the value of payments (Table 30). Western Grain Stabilization (WGS) benefits were assumed to be equal to WGS payments and therefore not included.

(iv)In year 30, a residual land value equal to the cost of the improvement was shown as an inflow. Sensitivity analysis was done with a zero residual value.

TABLE 30

FINANCIAL ANALYSIS: BENEFITS AND COSTS OF DRAINAGE

Sub-Basin	Net[1] Revenue Change	Crop Insurance Receipts	Crop Insurance Costs	Land Tax	Net Cash Flow
	($/acre)				
Silver	131.70	1.44	0.72	1.01	131.41
Lalby	93.36	1.64	0.82	0.89	93.33
Teepee	75.58	1.62	0.81	0.92	75.50
Dunvegan	94.77	1.64	0.82	0.89	94.67
Shoal	75.59	0.96	0.48	0.73	75.33

1. Taken from Table 28.

(v) Sensitivity analysis was done excluding crop insurance subsidies and land improvement grants.

Outflows

(vi) Incremental operating capital was calculated as 85 per cent of the change in production expenditure of the following year.

(vii) The loan for drainage was amortized over 10 years with an interest rate of 13 per cent.

(viii) Crop insurance payments were based on cost of production data and charged from the first year of production on drained land, on a pro rata basis.

(ix) Land, income and capital gains taxes were quantified. Land tax prior to drainage was zero on the wetlands, the land tax was phased in as land became productive. A marginal tax rate of 20 per cent was assumed, with sensitivity at 30 per cent. Capital gains tax was on one-half the residual value of land.

4.3 Results

4.3.1 Economic Analysis

Economic performance measures for partial drainage are presented in Table 31. Discounted investment costs (DIC's) ranged from $373 per acre for Peace to $589 per acre for Battle. Each of the five river basins showed positive results with net present values (NPV's) ranging from $250 per acre for Beaver to $904 per acre for Battle. The corresponding annual equivalent cash flows (AECF's) were $16 to $59 per acre. B/C ratios ranged from 1.23 to 1.70. Sensitivity analysis at a discount rate of 3 per cent improved the results while all values fell at the 7 per cent and 10 per cent rates, but drainage remained feasible in most cases (see Appendix III A). Drainage of the Beaver basin was not feasible at a 10 per cent discount rate. It was just marginal for the Athabasca basin. Feasibility was not affected by a 20 per cent decline in benefits or a 20 per cent increase in incremental costs.

TABLE 31

ECONOMIC PERFORMANCE MEASURES FOR DRAINAGE BY RIVER BASIN[1]

Results	DIC	NPV ($/acre)	AECF	B/C (ratio)
Peace	372.5	482.0	31.4	1.51
Athabasca	452.5	337.5	22.0	1.32
Beaver	502.0	250.4	16.3	1.23
North Saskatchewan	554.3	770.3	50.1	1.63
Battle	589.2	903.5	58.8	1.70

1. Partial Drainage (Scenario 2) based on 5 per cent discount rate, project life of 30 years, and no residual values.

As was expected, all cases improved with the inclusion of residual values, the Athabasca basin withstood a 10 per cent discount rate with a residual value included but the Beaver basin results remained negative (See Appendix III B). Results for full drainage are given in Appendixes III C & D. Overall the full drainage values were lower than those of partial drainage. Sensitivity to changes in variables was similar for both scenarios.

4.3.2 Financial Analysis

The analysis of cash flows after financing showed that there would be a net outflow in the first 3 to 10 years of a drainage project. For the Peace and Athabasca basins cash flows became positive in year four and for the North Saskatchewan in year five. Negative cash flows continued into year ten for the Beaver basin. Net cash flows after financing are shown in Figure 10 for the five sub-basins and in Figure 11 for the five major basins.

The financial analysis (shown in Table 32) indicated that drainage would be feasible at the farm level in each sub-basin and each major basin examined. The most favourable results were obtained for the Battle River Basin with an NPV before financing of $1 023 per acre and an AECF of $67 per acre. The corresponding values for the Beaver River Basin were $354 and $23 per acre. AECF's after financing were $52 for Battle and $17 for Beaver. After taxes at 20 per cent, these fell to $45 and $16 respectively, with a further reduction to $41 and $16 at the 30 per cent tax rate.

The exclusion of residual values reduced all results but drainage remained feasible for all cases examined (shown in Table 33). The removal of crop insurance subsidies had little impact on the results reducing net returns by only 1 to 2 per cent. The removal of the land improvement grants reduced net returns by more substantial amounts ranging from 9 per cent for Battle to 61 per cent for Beaver. However, all projects remained feasible (Table 34).

FIG. 10

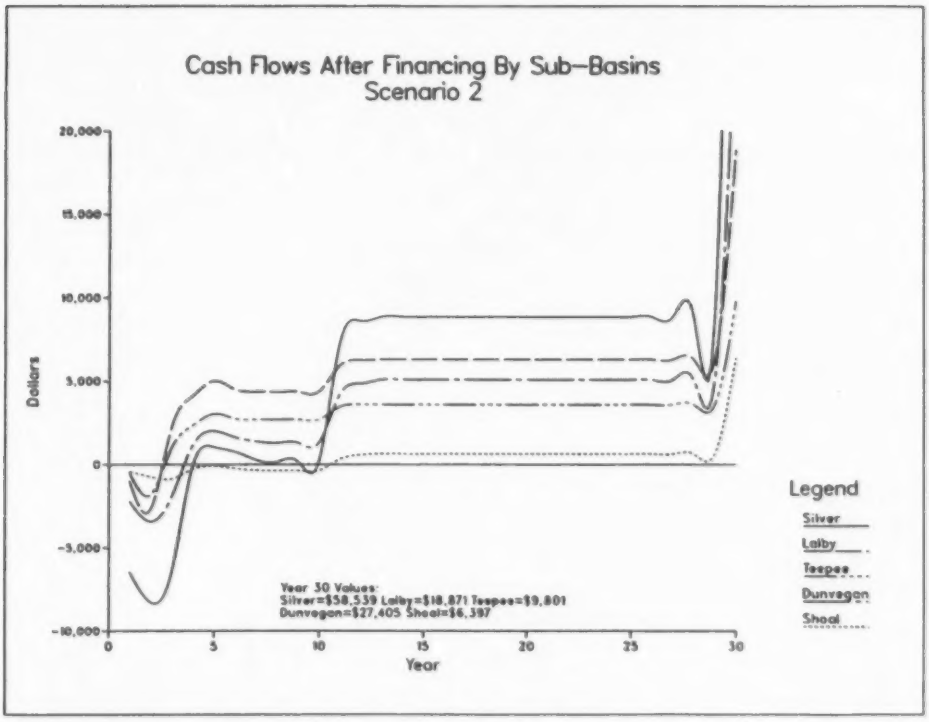
Cash Flows After Financing By Sub–Basins
Scenario 2
20,000
15,000
10,000
5,000
0
-5,000
-10,000
Dollars
0
5
10
15
20
25
30
Year
Year 30 Values:
Silver=$58,539 Lalby=$18,871 Teepee=$9,801
Dunvegan=$27,405 Shoal=$6,397
Legend
Silver
Lalby
Teepee
Dunvegan
Shoal

FIG. 11

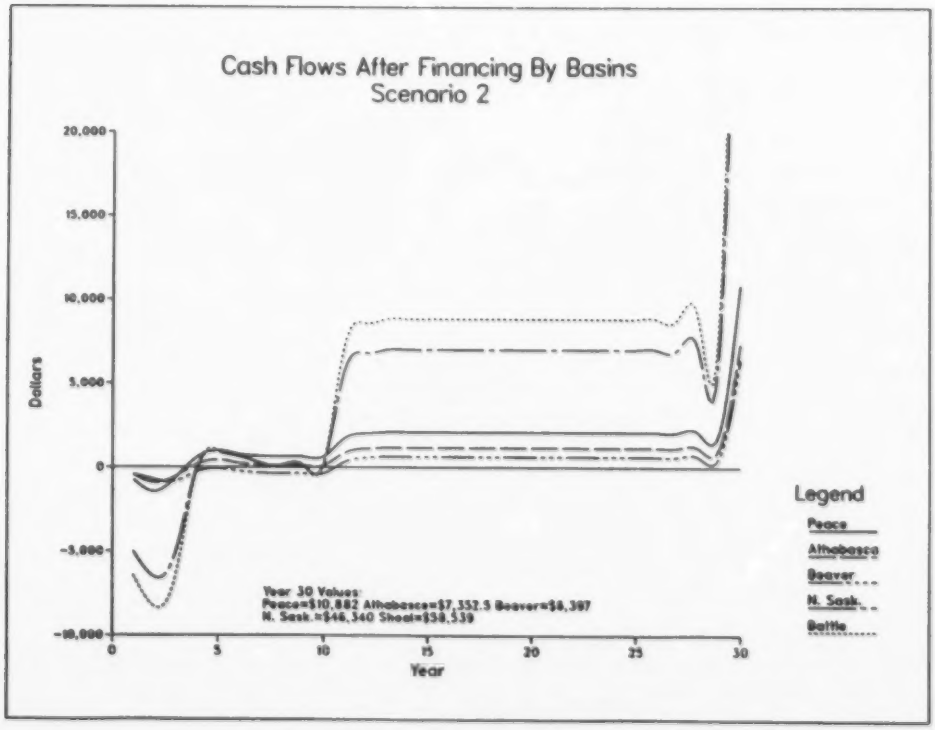
Cash Flows After Financing By Basins
Scenario 2
20,000
15,000
10,000
5,000
0
-5,000
-10,000
Dollars
0
5
10
15
20
25
30
Year
Year 30 Values:
Peace=$10,882 Athabasca=$7,352.5 Beaver=$6,397
N. Sask.=$46,340 Shoal=$58,539
Legend
Peace
Athabasca
Beaver
N. Sask.
Battle

TABLE 32

FINANCIAL ANALYSIS: DRAINAGE BY RIVER BASIN WITH RESIDUAL VALUE[1]

	B/C Ratio	AECF ($/acre)	NPV ($/acre)
Peace			
Before Financing	1.8	36.1	554.2
After Financing	1.5	31.4	482.3
After Financing & Tax (20%)	1.4	26.8	412.4
Tax Rate (30%)	1.3	24.6	377.5
Athabasca			
Before Financing	1.5	27.9	428.2
After Financing	1.3	22.7	348.6
After Financing & Tax (20%)	1.2	20.2	310.7
Tax Rate (30%)	1.2	19.0	291.7
Beaver			
Before Financing	1.4	23.0	353.5
After Financing	1.2	17.2	264.9
After Financing & Tax (20%)	1.1	16.1	247.2
Tax Rate (30%)	1.1	15.5	238.4
North Saskatchewan			
Before Financing	1.8	57.4	881.8
After Financing	1.4	45.3	696.6
After Financing & Tax (20%)	1.3	38.8	596.1
Tax Rate (30%)	1.3	35.5	545.9
Battle			
Before Financing	1.9	66.5	1 022.6
After Financing	1.4	52.3	804.1
After Financing & Tax (20%)	1.3	44.5	684.5
Tax Rate (30%)	1.3	40.6	624.8

1. Partial drainage (Scenario 2) based on 5 per cent discount rate and project life of 30 years.

TABLE 33

FINANCIAL ANALYSIS: DRAINAGE BY RIVER BASIN WITHOUT RESIDUAL VALUE[1]

	B/C Ratio	AECF ($/acre)	NPV
Peace			
Before Financing	1.7	30.0	460.7
After Financing	1.4	25.3	388.7
After Financing & Tax (20%)	1.3	21.4	328.2
Tax Rate (30%)	1.3	19.4	298.0
Athabasca			
Before Financing	1.4	20.6	316.4
After Financing	1.2	15.4	236.7
After Financing & Tax (20%)	1.2	13.7	210.0
Tax Rate (30%)	1.2	12.8	196.6
Beaver			
Before Financing	1.2	14.9	229.1
After Financing	1.1	9.2	140.8
After Financing & Tax (20%)	1.1	8.8	135.5
Tax Rate (30%)	1.1	8.6	132.8
North Saskatchewan			
Before Financing	1.7	48.5	745.6
After Financing	1.3	36.5	560.4
After Financing & Tax (20%)	1.3	30.8	473.6
Tax Rate (30%)	1.2	28.0	430.1
Battle			
Before Financing	1.8	57.1	878.0
After Financing	1.3	42.9	659.5
After Financing & Tax (20%)	1.3	36.1	554.4
Tax Rate (30%)	1.2	32.6	501.9

1. Partial drainage (Scenario 2) based on 5 per cent discount rate and project life of 30 years.

TABLE 34

FINANCIAL ANALYSIS: DRAINAGE BY RIVER BASIN WITH RESIDUAL VALUE[1] WITHOUT SUBSIDIES

	B/C Ratio	AECF ($/acre)	NPV ($/acre)
Peace			
Before Financing	1.8	35.3	542.4
After Financing	1.4	23.1	355.3
After Financing & Tax (20%)	1.3	20.2	310.8
Athabasca			
Before Financing	1.5	27.2	418.2
After Financing	1.2	12.7	194.6
After Financing & Tax (20%)	1.2	12.2	187.5
Beaver			
Before Financing	1.3	22.4	344.1
After Financing	1.1	6.2	96.0
After Financing & Tax (20%)	1.1	7.3	112.0
North Saskatchewan			
Before Financing	1.8	56.5	868.9
After Financing	1.3	38.7	595.0
After Financing & Tax (20%)	1.3	33.5	514.9
Battle			
Before Financing	1.9	65.6	1 008.8
After Financing	1.4	46.7	717.6
After Financing & Tax (20%)	1.3	40.0	615.4

1. Partial drainage (Scenario 2) based on 5 per cent discount rate and project life of 30 years.

4.4 Conclusion

The results indicate that for the five river basins examined drainage of temporary wetlands in the Battle River Basin would produce the highest on-farm net returns. The North Saskatchewan had the next best results, with returns falling by about 50 per cent for the remaining three basins. These results reflect the relatively high returns experienced in the Silver Creek sub-basin when compared with the other four sub-basins studied. This is despite Silver Creek having the highest per acre drainage costs.

Economic analysis showed that partial drainage withstood all changes applied to the discount rate, costs and benefits, with the exception of a 10 per cent discount rate in Beaver and Athabasca. Neither a 20 per cent increase in incremental costs nor a 20 per cent decline in benefits would make drainage infeasible. Feasibility was usually neutral to the exclusion of a residual land value. The exclusion of land development grants and crop insurance subsidies did not affect feasibility but together reduced net returns by between 10 and 63 per cent.

Full drainage of all wetlands was also found to be viable in all river basins examined. However, net returns per acre were lower than those for partial drainage. The economic NPV's for full drainage were 30 to 43 per cent lower than those for partial drainage. The differences in the financial NPV's were even greater, with results for full drainage being 43 to 73 per cent below the partial drainage results. Also, a few more cases were financially infeasible when adverse conditions were assumed for full drainage than for partial drainage.

5. DEEP PLOWING SOLONETZIC SOILS

5.1 Objectives

(i)To determine the economic viability of reclaiming dryland solonetzic soil through deep plowing techniques.

(ii)To evaluate the financial feasibility of deep plowing solonetzic soil on three soil zones in Alberta.

5.2 Methodology and Assumptions

5.2.1 Economic Analysis

To determine the benefits and costs of reclaiming solonetzic soils, the following methods and assumptions were used:

(i)Deep plowing on 19 test plots in the County of Paintearth were carried out from 1975 to 1983. The crops which were grown included wheat, barley, oats and canola. The sample size for canola was too small to be used in the economic analysis.

(ii)Deep plowing was the only management alternative considered.

(iii)The average dryland crop yields of solonetzic soils were supplied by G. Patterson (Agriculture Canada). Potential yield increases as a result of deep plowing are given in Table 35. These data originate from test plot work in the County of Paintearth carried out by the Soils Branch, Alberta Agriculture.

(iv)The cost of deep plowing included three additional cultivation operations to achieve good seedbed preparation after deep plowing.

(v)Annual tractor use was assumed to be 500 hours. Data on custom rates and machinery operating costs were used for the required cultivation operations.

TABLE 35

YIELD INCREASES RESULTING FROM DEEP PLOWING[1]

Soil Zone	Wheat	Barley	Oats
	--------(bu/acre)-------		
Black	12.7	25.5	18.7
Dark Brown	7.4	4.5	15.7
Brown	5.4	-	-

1. Land Use Branch, Alberta Agriculture.

(vi)The project life was ten years.

(vii)Sensitivity analysis was carried out to measure the economic impact of fluctuations in the following variables:

a] Discount rate: 5 per cent ± 2 per cent;
b] Gross revenue: 10 and 20 per cent;
c] Plowing costs: + 50 per cent;
d] Yield reclamation rate;
e] Worst case scenario; and
f] Residual value included.

5.2.2 Financial Analysis

The economic analysis was based on a parcel of one acre. To permit the calculation of maximum grants attainable, an assumption had to be made in regards to the scale of such a project. Analysis for financial feasibility was based on reclaiming an 80-acre parcel (all results presented on an acre basis).[1]

1. Discussion with J. Hermans, Conservation and Development Branch, Alberta Agriculture.

Inflows

(i) Producers who use this soil improvement method are eligible for a land improvement grant (rebate). This grant is received annually for five years. Each annual receipt is the lowest of either $700, 7 per cent of the investment or the interest payments on the investment.[1]

(ii) Equity was assumed to be zero on any capital investment required, that is, the investment required by this project was assumed to be financed totally by borrowings.

(iii) Residual value was assumed to be equal to the sum of all land improvement costs. A value of zero was used as a sensitivity.

(iv) Western Grain Stabilization (WGS) benefits were assumed to be equal to WGS payments; therefore they were not included.

(v) Sensitivity analysis was done excluding land improvement grants.

Outflows

(vi) The interest rate used for loans was 13 per cent, with a repayment period of 10 years.

5.3 Results

5.3.1 Economic Analysis

Results expressed as net present value (NPV), annual equivalent cash flow (AECF), discounted investment costs (DIC) and benefit cost ratio (B/C) are summarized in Table 36.[2] The discounted cost of deep

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1. Loree, Wilson J., Assistance Available for Alberta Farmers, Alberta Agriculture, Agdex 871, 1985.

2. For a more detailed explanation of the economic analysis procedure see the Introduction.

TABLE 36

ECONOMIC PERFORMANCE MEASURES FOR SOLONETZIC SOIL RECLAMATION[1]

Soil Zone	DIC	NPV ($/acre)	AECF	B/C Ratio
Black	93	315	40.76	4.37
Dark Brown	93	105	13.60	2.13
Brown	93	90	11.69	1.97

1. Base scenario for all soil zones, i.e., 5 per cent discount rate, average yields and base case response rate.

plowing was $93 per acre. The results indicated that the net benefit of deep plowing decreased when moving from Black soils (NPV = $315 per acre) to the Dark Brown soils (NPV = $105 per acre) to the Brown soils (NPV = $90 per acre). The Black soil zone had a substantially high B/C ratio of 4.37 compared to a more moderate 1.97 in the Brown zone.

An important factor in deep plowing is the rate of reclamation and the length of time over which the benefits will accrue. A constant yield was used over the life of the project of ten years. Sensitivity analysis was done on yield response to examine the effects of a non-constant yield which remained below the potential for the first several years. The response rates from Table 37 were used.

These response rates are a percentage of the potential incremental yield from deep plowing. In all soil zones the B/C ratio remained above 1.0 even when subjected to the slowest response rate of 'response 3'. Under the slowest response scenario the NPV's in the Black, Dark Brown and Brown soil zones dropped by 60 per cent, 87 per cent and 93 per cent respectively. These results are encouraging, since the slowest response rate (which is unlikely to occur) does not force the B/C ratios below 1.0.

TABLE 37

RESPONSE RATES

Year[1]	1	2	3	4	5	6	7	8-10
	(%)							
Response 1	0	0	50	100	100	100	100	100
Response 2	0	0	25	75	100	100	100	100
Response 3	0	0	15	30	45	60	75	100
Base Case	0	100	100	100	100	100	100	100

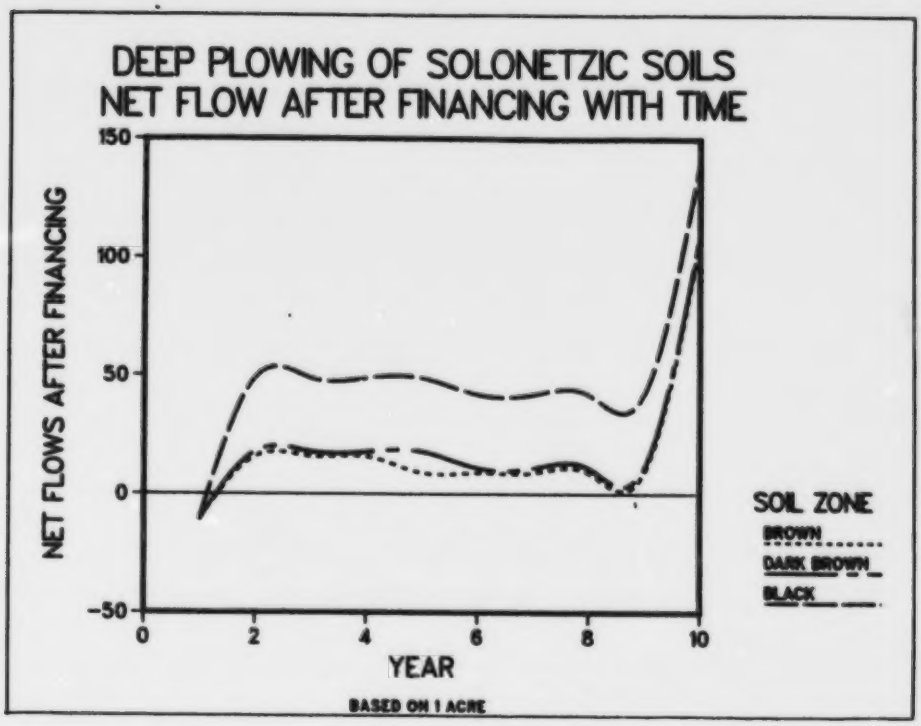
1. In Year 1, the deep plowing was done; therefore no crop was planted.

An increase in the plowing costs of 50 per cent had a significant effect, reducing NPV's by 37 per cent in each soil zone. A 20 per cent decrease in crop prices reduced NPV's by 35 per cent. The worst case scenario (price decrease, plowing cost increase, discount rate of 7 per cent and response rate number 3), had very significant effects on all soil zones. The Black soils remained just slightly above a break even level; however, the Dark Brown and Brown soils showed negative results. Inclusion of a residual land value increased NPV's and AECF's by 27 to 45 per cent and B/C ratios by 20 per cent. For more details on sensitivity analysis refer to Appendix IV.

5.3.2 Financial Analysis

An analysis of the cash flow streams generated showed that a negative flow of $98 per acre would occur only in the first year. The inclusion of financing reduced this negative flow to $11. The further inclusion of taxes in the analysis made the flow a positive $9.58 per acre (see Figure 12).

FIG. 12



From Table 38 it is seen that deep tillage was financially feasible for all soil zones and analysis levels. The Black soil zone showed an AECF more than twice as large as the second ranked Dark Brown. Looking at NPV's and B/C ratios did not change either the ranking or the feasibility. Eliminating the residual value, though, it reduced the level of profitability (the AECF to total resources on Black soil went from $48.30 to $40.51 per acre), did not make any cases infeasible (see Table 39). Removal of the land improvement grant reduced net returns by 8 per cent on Black soils and by about 20 per cent on Dark Brown and Brown soils (see Table 40). The sensitivity analysis presented in Appendix IV shows that none of the variances tested made the project infeasible.

TABLE 38

FINANCIAL ANALYSIS: DEEP PLOWING SOLONETZIC SOILS[1]
WITH RESIDUAL VALUE

	AECF ($/ac)		
	Total Resources	After Financing	After Fin & Tax
Black	48.30	46.18	38.27
Dark Brown	21.13	19.00	16.53
Brown	19.37	17.25	15.13

	NPV ($/ac)		
	Total Resources	After Financing	After Fin & Tax
Black	372.99	356.57	295.52
Dark Brown	163.14	146.72	127.64
Brown	149.60	133.18	116.81

	B/C (ratio)		
	Total Resources	After Financing	After Fin & Tax
Black	5.00	2.53	2.01
Dark Brown	2.75	1.63	1.51
Brown	2.60	1.57	1.47

1. Based on a 5 per cent discount rate and a 10-year project.

TABLE 39

FINANCIAL ANALYSIS: DEEP PLOWING SOLONETZIC SOILS[1]
NO RESIDUAL VALUE

	AECF ($/ac)		
	Total Resources	After Financing	After Fin & Tax
Black	40.51	38.39	31.26
Dark Brown	13.34	11.21	9.52
Brown	11.58	9.46	8.11

	NPV ($/ac)		
	Total Resources	After Financing	After Fin & Tax
Black	312.83	296.40	241.37
Dark Brown	102.98	86.55	73.49
Brown	89.44	73.02	62.66

	B/C (ratio)		
	Total Resources	After Financing	After Fin & Tax
Black	4.35	2.27	1.84
Dark Brown	2.10	1.37	1.30
Brown	1.96	1.31	1.26

1. Based on a 5 per cent discount rate and a 10-year project.

TABLE 40

FINANCIAL ANALYSIS: DEEP PLOWING SOLONETZIC SOILS[1]
WITH RESIDUAL VALUE
WITHOUT SUBSIDIES

	AECF ($/ac)		
	Total Resources	After Financing	After Fin & Tax
Black	48.30	42.33	35.19
Dark Brown	21.13	15.15	13.45
Brown	19.37	13.40	12.05

	NPV ($/ac)		
	Total Resources	After Financing	After Fin & Tax
Black	372.99	326.87	271.76
Dark Brown	163.14	117.02	103.88
Brown	149.60	103.48	93.05

	B/C (ratio)		
	Total Resources	After Financing	After Fin & Tax
Black	5.00	2.40	1.94
Dark Brown	2.75	1.50	1.42
Brown	2.60	1.44	1.38

1. Based on a 5 per cent discount rate and a 10-year project.

5.4 Conclusion

In summary, reclamation of solonetzic soils through deep plowing was shown to be economically and financially feasible, given the assumptions used. With most reasonable variations in costs and revenues, all projects remained feasible. Negative flows occurred only in the first year of the project; with financing, the negative flows were relatively small ($11 per acre). AECF's after financing were slightly higher than the economic AECF's, indicating adequate levels of support through transfer payments and little need for further financial incentives. Removal of grants reduced net returns by 8 to 20 per cent. What seems to be needed to encourage deep plowing of solonetzic soils is more demonstration of its success and more information on positive results.

6. LIMING ACID SOILS

6.1 Objectives

(i)To determine the economic benefits and costs of applying lime to acid soils for the purpose of increasing soil productivity.

(ii)To evaluate the financial feasibility of liming acid soils.

6.2 Methodology and Assumptions

6.2.1 Economic Analysis

To evaluate the on-farm benefits and costs of liming acid soils, the following assumptions were made:

(i)The analytical methods and the basic assumptions outlined in the Introduction apply to this management alternative except where otherwise stated.

(ii)Three major soil zones, Gray (Peace River Region), Dark Brown and Black (Northeast Region) were identified as having acid soils that require lime treatment.

(iii)The crop rotations assumed were 1/4-3/4 on Gray, 1/3-2/3 on Dark Brown soils and continuous cropping on Black. A ten-year period of analysis was used.

(iv)Lime was applied to the crop acreage before seeding in the first year and to the remaining acreage in the second year. No further liming was done. The rate of lime application and average related costs are given in Table 41.

(v)Before liming, crop yields were at 16 to 20 per cent below benchmark or normal yields. Increases in yields were minimal in the first year after liming, but they rose steadily until the fifth year, then remained constant. The additional yields and revenues five years after liming are presented in Table 42.

TABLE 41

RATE AND COST OF LIME APPLICATION

Item	Cost
Cost of Lime	$ 10/ton
Average Transport Cost	$ 25/ton
Application Charges	$ 3/ton
Estimated Total Cost	$ 57/acre

Rate of application $1.5 ton/acre

TABLE 42

INCREMENTAL YIELDS AND REVENUES[1]

Crop	Gray		Dark Brown		Black	
	Inc. Yield (bu/ac)	Inc. Value ($)	Inc. Yield (bu/ac)	Inc. Value ($)	Inc. Yield (bu/ac)	Inc. Value ($)
Canola Fallow	2.9	3 191	3.9	3 403	4.0	4 244
Canola Stubble	0.0	000	0.0	000	0.0	000
Barley Stubble	6.6	3 992	9.0	4 838	8.3	2 835
Wheat Fallow	0.0	000	5.4	7 021	5.3	346
Wheat Stubble	4.1	1 955	4.6	4 110	4.6	2 953
Oats Stubble	0.0	000	0.0	000	4.1	480
Summerfallow	0.0	000	0.0	000	0.0	000
Total		9 138		19 372		10 858

1. Based on the crop mix and prices given in the Introduction and the crop rotations identified in assumption (iii).

(vi) Incremental yields were the direct benefit of liming; and there were no additional costs after liming.

(vii) Sensitivity analysis was done to accommodate some possible variations in crop prices, yields and input costs.

6.2.2 Financial Analysis

To determine whether existing incentives make investment in liming feasible for the farmer, the following transfer payments were measured:

Inflows

(i) Producers who use this soil improvement method are eligible for a land improvement grant. This grant is received annually for five years. Each annual receipt is the lowest of either $700, 7 per cent of the investment or the interest payments on the investment.[1]

(ii) The lime transport grant is equal to 80 per cent of the cost of transportation plus handling costs of lime exceeding $5.50 per tonne. Average handling and transport costs were estimated at $25 per tonne[1].

(iii) It was assumed that all capital investments were financed through loans.

(iv) Western Grain Stabilization (WGS) benefits were assumed to be equal to WGS payments and therefore not included.

(v) Residual values were assumed to be equal to land improvement costs. For sensitivity, they were also tested at a zero value.

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1. Loree, Wilson J., Assistance Available for Alberta Farmers, Alberta Agriculture, Agdex 871, 1985.

(vi)Sensitivity analysis was done excluding land improvement and lime transport grants.

Outflows

(vii)Loans were capitalized over 10 years at a 13 per cent interest rate.

(viii)The producer was assumed to pay off all outstanding loans at the end of the project. Thus a residual capital repayment was determined.

(ix)No changes in crop insurance and land taxes were assumed.

6.3 Results

6.3.1 Economic Analysis

The results of discounting the incremental costs and returns of liming acid soils are provided in Table 43.

TABLE 43
ECONOMIC PERFORMANCE MEASURES FOR LIMING ACID SOILS[1]

Soil Zone	Discounted Incremental Revenue	DIC	NPV	AECF	B/C	IRR
	($/acre)				(ratio)	(%)
Gray	90	54	36.75	4.76	1.68	18
Dark Brown	103	54	49.40	6.40	1.92	22
Black	107	54	50.32	6.52	1.94	22

1. Discount rate at 5 per cent.

The analysis indicated that if all other costs, managerial and environmental factors remained constant during the ten year period, the cost of liming would be more than justified by the resultant yield increases in each soil zone examined. The internal rates of return were 18 per cent for the Peace River Region, 22 per cent for the Dark Brown soil zone and 22 per cent for the Black (Northeast) soil zone. The B/C ratios above 1.0 showed that investments in liming would have positive returns for each soil zone considered. The returns in the Dark Brown and Black soils were slightly greater than those on the Gray.

Sensitivity analysis was carried out to measure the effect of some possible variations in crop prices, yields and input costs. Liming increases the effectiveness of fertilizers on crops and in normal cases does not necessitate the use of additional fertilizers.[1] Even with 10 per cent and 20 per cent increases in fertilizer costs, however, the B/C ratios for each region only fell by a few percentage points and remained above 1.0.

Another possible variation is the yield increase due to liming. If yields do not go as high as the expected benchmarks, the benefits of investing in liming will be reduced. On all soil zones, reasonable returns to investment in liming were obtained even at yields 20 per cent below the potential yield increases.

Further analysis with variations in the cost of liming showed that a 10 per cent increase above the estimated $57 per acre was still tolerable on all three soil zones. In this case, the annual equivalent cash flow for Gray was reduced to $4.23 per acre; $5.93 per acre for the Dark Brown soil zone and $5.82 per acre for the Black soils. Even a 20 per cent increase in costs would not hurt the project if the benchmark yields were attained. Although the reduction in value of the AECF was 22 per cent for Gray and 15 per cent for Dark Brown soil, the values remained positive. Variations in the discount rate did not affect the feasibility of liming; at a 7 per cent discount rate the AECF's fell by

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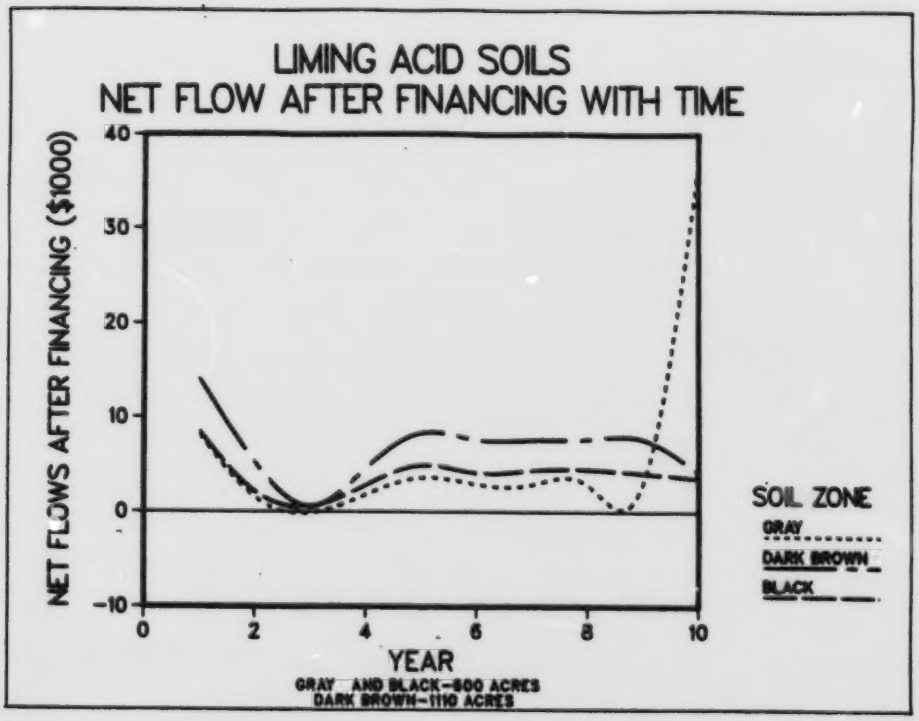
1. Personal consultation with Doug Penney, Soil Specialist, Alberta Agriculture.

about $1.00 per acre and the B/C ratios by less than 0.2 points. NPV's and AECF's were increased by us to 35 per cent and B/C ratios by up to 17 per cent when a residual land valu was included. Details of sensitivity analysis are given in Appendix V.

6.3.2 Financial Analysis

The analysis of the cash flow streams showed negative flows in the range of $20 to $33 per acre ($12 000 to $20 000 per 600-acre unit) for the first year and $1.25 to $8 per acre ($750 to $4 800 per 600-acre unit) for the second year. The inclusion of financing in the analysis eliminated the large negative flows in the first two years, while it created a negative flow of $0.09 per acre in the third year for the Gray (see Figure 13). The further inclusion of taxes increased the occurrence of negative cash flows in the third year, making them $0.84 per acre for the Gray and $0.58 for the Dark Brown soils.

FIG. 13



As seen in Table 44 all cases show that liming was financially feasible. Differences between the feasibility on Dark Brown and Black soils were not significant, but both were slightly better than that of the Gray.

Elimination of residual values substantially reduced the magnitude of the benefits, though it did not render any cases infeasible (see Table 45). The removal of the lime transport grant had the effect of reducing net returns by about 22 per cent. The combined effect of removing the land improvement grant and the lime transport grant was to reduce net returns by between 30 and 35 per cent (see Table 46). None of the changes tested through sensitivity analysis were sufficient to make any projects marginally feasible or infeasible (see Appendix V).

6.4 Conclusion

Transport costs tend to be the major constraint to the practice of liming. The present cost of lime, coupled with the expected increase in yields for the major crops and the period of the effectiveness of liming, gives substantial economic justification for liming as a remedy to acidic soils. Another justification for lime treatment not analysed in this paper is the long-run maintenance of soil productivity even where continuous use of nitrogen fertilizers would otherwise tend to decrease soil pH and result in lower yields. Expanded commercial activities related to lime and its transportation is also beneficial to the regional economy. With liming, a wider range of crop mix is possible, which helps to diversify production for individual farms as well as for the region as a whole. In every case, the benefits of agricultural liming are a long-run consideration.

Although some of the non-quantifiable benefits of liming acid soils were not considered, the analysis indicates that under the assumptions adopted, liming acid soils is an economically feasible alternative. Taking into account existing subsidies as well as other transfer payments (including interest payments), liming was shown to be financially

TABLE 44

FINANCIAL ANALYSIS: LIMING ACID SOILS[1]
WITH RESIDUAL VALUE

	AECF ($/ac)		
	Total Resources	After Financing	After Fin. & Tax
Gray	12.20	9.50	8.38
Dark Brown	13.76	10.71	9.34
Black	13.89	11.20	9.74

	NPV ($/ac)		
	Total Resources	After Financing	After Fin. & Tax
Gray	94.18	73.34	64.70
Dark Brown	106.26	82.73	72.10
Black	107.29	86.46	75.20

	B/C (Ratio)		
	Total Resources	After Financing	After Fin. & Tax
Gray	2.76	1.55	1.46
Dark Brown	2.99	1.62	1.50
Black	3.00	1.65	1.52

1. Based on a 5 per cent discount rate and a 10-year project.

TABLE 45

FINANCIAL ANALYSIS: LIMING ACID SOILS[1]
NO RESIDUAL VALUE

	AECF ($/ac)		
	Total Resources	After Financing	After Fin. & Tax
Gray	7.67	4.97	4.30
Dark Brown	9.23	6.18	5.26
Black	9.36	6.67	5.66

	NPV ($/ac)		
	Total Resources	After Financing	After Fin. & Tax
Gray	59.19	38.35	33.21
Dark Brown	71.27	47.74	40.61
Black	72.30	51.47	43.71

	B/C (Ratio)		
	Total Resources	After Financing	After Fin. & Tax
Gray	2.10	1.29	1.24
Dark Brown	2.33	1.36	1.27
Black	2.35	1.39	1.31

1. Based on a 5 per cent discount rate and a 10-year project.

TABLE 46

FINANCIAL ANALYSIS: LIMING ACID SOILS[1]
WITH RESIDUAL VALUE
WITHOUT SUBSIDIES

	AECF ($/ac)	
	Total Resources	After Financing	After Fin. & Tax
Gray	9.35	5.99	5.57
Dark Brown	10.92	7.52	6.41
Black	11.04	7.69	6.93

	NPV ($/ac)	
	Total Resources	After Financing	After Fin. & Tax
Gray	72.16	46.27	43.05
Dark Brown	84.33	58.07	49.52
Black	85.27	59.39	53.54

	B/C (Ratio)	
	Total Resources	After Financing	After Fin. & Tax
Gray	2.35	1.35	1.32
Dark Brown	2.58	1.44	1.35
Black	2.59	1.45	1.39

1. Based on a 5 per cent discount rate and a 10-year project.

feasible for the farmer, with AECF's after financing and taxes being greater than the economic AECF's. The cash flows were positive almost immediately, indicating no need for additional financial incentives. Removal of subsidies would have a substantial impact reducing net returns by 30 to 35 per cent. This is another case of an alternative which needs the tools of education and demonstration of successful results to promote its practice.

7. SUMMERFALLOW REDUCTION

7.1 Objectives

(i)To determine the economics of summerfallow reduction in various crop rotation alternatives throughout the province.

(ii)To evaluate the financial feasibility of summerfallow reduction on the five major soil zones in Alberta.

7.2 Methodology and Assumptions

7.2.1 Economic Analysis

To determine the on-farm benefits and costs of summerfallow reduction, the following methods and assumptions were used:

(i)A whole-farm simulation model of dryland cereal and oilseed production in western Canada was employed as the main analytical tool.[1] The model was modified from its original version for purposes of this study. A project life of nine years was used.

(ii)The method of analysis (marginal economic analysis); system of reporting results (returns to land, labour, management and existing investment); and the assumptions (related to farm size, crop mix, yields, prices and inputs), outlined in the Introduction apply to this study unless otherwise stated.

(iii)The rotations evaluated were: 1/2-1/2; 1/3-2/3; 1/4-3/4 and continuous cropping (C/C). The rotation 1/3-2/3, for example, means that one third of the cultivated land is in fallow every year. Continuous cropping, therefore, is all land cropped every year.

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1. Zentner, R.P., et al, "A Simulation Model for Dryland Crop Production in the Canadian Prairies", Agricultural Systems, Vol. 3 No. 4,. 1978, pp. 241 - 257.

Stubble yields were maintained after summerfallow reduction at the same level as before reduction.

(iv) Machinery complements and management practices were derived for a typical farm for each of the soil zones and the corresponding farm sizes and crop mix.

(v) Machinery was replaced at 87 per cent of its life. Only replacement machinery was treated as a capital investment.

(vi) Chemical costs were based on the percentage of cropped acreage that was sprayed annually.[1] The highest cost was for C/C with all cropped acreage sprayed and reduced for less intensive cropping as follows:

a] C/C 100%; b] 1/4-3/4 80%; c] 1/3-2/3 50%; and d] 1/2-1/2 25%.

(vii) The Black soil zone was split into two areas, Central and Northeast. Assumptions for the Central area are as explained in the Introduction. For the Northeast area (Vegreville), 600 cultivated acres were assumed with the following crop mix, and stubble/fallow yields (fertilizer requirements were the same as for Central):

Crop Mix and Yields	Wheat		Barley		Canola		Oats	
	(Fa.)	(St.)	(Fa.)	(St.)	(Fa.)	(St.)	(Fa.)	(St.)
(%)	29		29		29		13	
(bu/ac)	33.3	29.0	50.2	41.5	24.7	19.2	63.7	51.6

(viii) Sensitivity analysis was carried out to measure the economic impact of the following fluctuations in major variables:

a] Discount Rate: 5 per cent ± 2 per cent;

b] Yield: stubble yield ± 20 per cent and 1974-82 yield data used in series;

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1. Based on CRD's and informed estimates, Alberta Agriculture.

c] Prices: output prices ± 20 per cent;

d] Worst case scenario: 20 per cent decrease in yields and prices and discount rate = 7 per cent; and

e] Machine replacement policy: varied from 87 per cent to 50 per cent of life.

7.2.2 Financial Analysis

Marginal analysis was originally employed in the economic analysis; for example, conversion of 1/3-2/3 to C/C on a 600-acre farm involved moving from 400 acres to 600 acres farmed with a 200-acre increase. Additional inflows and outflows for financial analysis were based on such a change.

Inflows

(i) Crop insurance claims were assumed to be twice the value of payments based on the federal government subsidization of the program.[1]

(ii) Loans were assumed for the full amount needed for capital expenditure (i.e. machinery). Some soil zones had zero expenditure. Since the simulation model used in the analysis is only for 10 years, a question of when machinery would be otherwise replaced arose. There would only be small differences for tillage equipment, but for self-propelled equipment (e.g. combines), a correction factor was adopted to account for the value at the time of purchase.

(iii) A zero residual value to land was assumed at the end of year 9 because the land improvements due to management practices could not be measured.

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1. Alberta Hail and Crop Insurance Corporation, 16th Annual Report; year ended March 31, 1984.

(iv)The salvage value of all equipment was captured at the end of the project life. This salvage value equals the undepreciated value of machinery.

(v)Sensitivity analysis was done excluding crop insurance subsidies.

Outflows

(vi)A residual capital repayment was determined based on the assumption that the farmer paid off the remainder of the loan at the end of the project period.

(vii)Crop insurance payments were calculated based on soil zone, land class, crop mix and 60 per cent coverage with the high price alternative. These estimates were derived using information supplied by the Hail and Crop Insurance Corporation. In each soil zone a representative county or municipality was chosen to provide an estimate of the percentages of A, B, C, D and E land.

(viii)Capital cost allowance for tax purposes was assumed to be 10 per cent on tillage equipment and 15 per cent on self-propelled equipment. This allowance was adjusted for the correction factor in point (ii).

(ix)Interest payments on loans were included, at a rate of 13 per cent with a repayment period of 10 years.

7.3 Results

7.3.1 Economic Analysis

Results are summarized in Table 47. With the assumptions and methodology adopted, all soil zones except Brown showed economic feasibility in moving from the base situation towards a more intensive cropping rotation. On soils other than Brown, moving from a 1/3-2/3 or

TABLE 47

ECONOMIC PERFORMANCE MEASURES FOR SUMMERFALLOW REDUCTION

Soil Zone (Cultivated Acres)	DIC[2]	NPV	AECF	B/C
		($/ac)		(ratio)
A. Brown (1 500 acres)				
1. 1/2-1/2 vs 1/3-2/3	12	-14.80	-2.08	0.80
2. 1/2-1/2 vs 1/4-3/4	20	-55.35	-7.79	0.62
3. 1/3-2/3 vs 1/4-3/4	8	-40.54	-5.70	0.43
B. Dark Brown (1 110 acres)				
1. 1/3-2/3 vs C/C[1]	31	64.55	9.08	1.31
2. 1/4-3/4 vs C/C	22	62.53	8.80	1.44
3. 1/3-2/3 vs 1/4-3/4	8	2.03	0.29	1.03
C. Black (Northeast) (600 acres)				
1. 1/3-2/3 vs C/C	23	51.34	7.22	1.29
2. 1/4-3/4 vs C/C	16	32.26	4.54	1.25
3. 1/3-2/3 vs 1/4-3/4	7	19.08	2.68	1.38
D. Black (Central) (600 acres)				
1. 1/3-2/3 vs C/C	23	80.40	11.31	1.45
2. 1/4-3/4 vs C/C	16	75.79	10.66	1.60
3. 1/3-2/3 vs 1/4-3/4	7	4.62	0.65	1.09
E. Gray (Peace River) (600 acres)				
1. 1/3-2/3 vs C/C	21	29.89	4.21	1.19
2. 1/4-3/4 vs C/C	15	22.89	3.22	1.20
3. 1/3-2/3 vs 1/4-3/4	6	7.01	0.99	1.15

1. C/C represents continuous cropping.

2. Real discount rate of 5 per cent was used.

a 1/4-3/4 rotation to C/C always proved to be the most economically attractive. The B/C ratios and NPV's were marginal on the Dark Brown, Black (Central) and Gray (Peace River) for the change from 1/3-2/3 to 1/4-3/4 rotation alternative. Even on the Black (Northeast) soil, the NPV was marginal for this alternative, while the B/C ratio was relatively higher than on the other soils. On the Brown soils, B/C ratios were less than 1.0 and NPV's negative for all scenarios examined. This indicated that more intensive cropping on Brown soils would not be economically feasible with the prices, yields and crop mix used for analysis.

The balance of this discussion will concentrate on the two most feasible cropping alternatives: 1/3-2/3 to C/C; and 1/4-3/4 to C/C. With the base situation (ten-year average stubble/fallow yields and prices), there was no variation in gross revenue over the project life. The change from 1/3-2/3 to C/C was the most economically sound rotation alternative evaluated. This was due in part to the relationship between stubble and fallow yields and the relationship between increased costs (including investments) and increased acreage cropped. As might be expected, the highest AECF of $11.31 per acre was in the Black (Central) soil zone. Apart from the negative value for the Brown soils, the lowest AECF was $4.21 per acre in the Peace River region.

Discounted investment costs (DIC) represented the total increase in costs in the first year of the management change. These costs consisted mainly of additional production costs, with a portion devoted to capital (equipment) purchases. The DIC's per acre were greatest in the Dark Brown soil zone, because, for any given crop rotation change, the absolute increase in acreage cropped was greatest on the larger Dark Brown soil farms. An investment in additional machinery was therefore required in that zone. The DIC's for the 1/3-2/3 to C/C alternative was $31 per acre on Dark Brown, $23 per acre on Black and $21 per acre on Gray. The proportion of investment costs devoted to equipment purchases increased when the machine replacement policy was changed from 0.87 to 0.50 of its life.

Sensitivity analysis was employed to evaluate the stability of a project when subjected to variations in the major assumptions. Changes in the discount rate had very little effect on project feasibility. There was an average change of 5 to 15 per cent in the NPV per acre and only cents difference in the AECF per acre with a ±2 per cent change in the discount rate. Both yield and price variations had a significant impact on the B/C's and NPV's in all soil zones. A 10 per cent reduction in prices resulted in a significant drop in the NPV's for all soil zones. The smallest decrease (in the NPV) was 32 per cent in the Black (Central) zone and the largest decrease was 64 per cent in the Peace River region. A 20 per cent reduction in prices had double the effect of a 10 per cent reduction and forced the B/C ratio below 1.0 in the Peace River region. A 20 per cent reduction in stubble yields reduced the NPV per acre from $65 to -$73 in the Dark Brown 1/3-2/3 to C/C scenario. Similar results occurred in all soil zones. On the other hand, an increase of 20 per cent in the stubble yields showed the same magnitude of change but in a positive direction.

An important consideration to the feasibility of more intensive cropping is income variability. A nine-year yield series (1974-82) was used. The effect of low (and in certain years negative) net revenues on the over all feasibility of moving towards more intensive cropping was examined by allowing both the stubble and fallow yields to vary on a year-to-year basis. In all soil zones except Gray (Peace River), the NPV's per acre decreased when a nine-year yield series was used. The Peace River region was affected the least; NPV per acre did not change for the 1/3-2/3 to C/C and NPV per acre increased by almost 10 per cent for the 1/4-3/4 to C/C alternative. The Dark Brown zone was affected the most; NPV per acre decreased by 42 per cent (1/3-2/3 to C/C). In all study areas (excluding Brown) previously positive results remained positive.

Although price changes also had a large impact on the outcome of the projects a 20 per cent decrease in prices lowered the NPV below zero in only the Peace Region. The NPV's in other zones remained marginally

above zero. In the worst case scenario of a 20 per cent reduction in yields and prices and a 7 per cent discount rate, no projects were economically feasible. It is, however, highly unlikely that this combination would occur repeatedly over nine years.

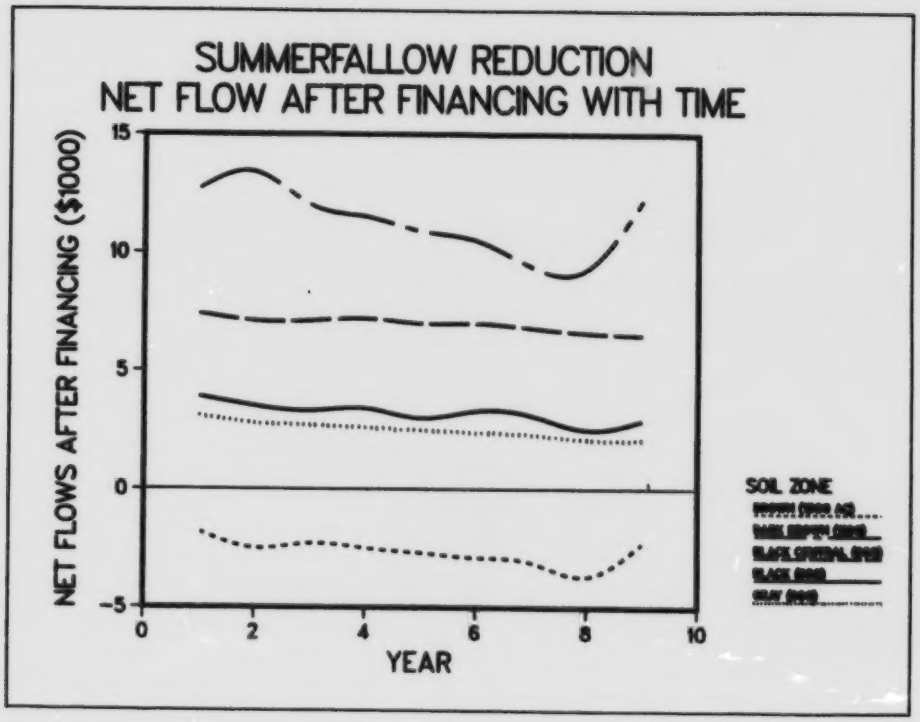
Another major influence on the decision to crop more intensively is the possible additional machinery required. For the purpose of sensitivity analysis, the machinery replacement policy was lowered from 87 per cent to 50 per cent of its life. This forced the NPV's for both the Black (Northeast) and Gray (Peace River) zones to negative figures. With conversion from 1/3-2/3 to C/C, the Dark Brown and Black (Central) zones had NPV per acre decreases of 15 per cent and 75 per cent respectively; however, they did remain positive. A summary of the sensitivity analysis is provided in Appendix V.

7.3.2 Financial Analysis

The analysis of the cash flow streams generated showed that most flows were positive. A few exceptions exist. In the fourth year in the case of 1/3-2/3 to 1/4-3/4 for the Black (Central) soil zone, there was a negative flow of $0.07 per acre ($40 per 600-acre unit). After financing, there were no negative flows except on the Brown soil zone (Figure 14). For all cases in the Brown soil zone before financing, substantial negative flows, between $0.20 and $18 per acre ($118 to $10 842 per 600 acre unit), occurred for all years but the last. This situation in the Brown zone is caused by the accelerated equipment replacement requirement while the gains in income were not as substantial as those for the other soil zones.

Table 48 shows that in all cases, except for the Brown soil zone, a reduction in summerfallow was financially attractive, based on AECF's. In fact, the larger the reduction in summerfallow the higher the AECF per acre. The level of analysis (that is, returns to total resources, after financing, or after financing and taxes) did not substantially change the relative effectiveness of this procedure (whether by soil zones or by level of reduction of summerfallow). If this alternative

FIG. 14



were compared by NPV's or B/C values instead of by AECF's, the ordering was not affected (see Tables 49 and 50). The exclusion of crop insurance subsidies had some impact on the results, reducing positive net returns by 10 to 25 per cent and more than doubling the losses on the Brown soil zone (see Tables 51, 52 and 53). Changes in discount rate or tax rate did not change the level of profitability sufficiently to affect feasibility (see Appendix VI).

7.4 Conclusion

In summary, with the exception of the Brown soil zone, more intensive cropping was shown to be economically feasible under the original assumptions used. Stubble yield and/or price reductions of 10 per cent had marginal impact on the results, but a 20 per cent reduction in stubble yields produced negative returns. This sensitivity to

TABLE 48

FINANCIAL ANALYSIS: SUMMERFALLOW REDUCTION[1]
ANNUAL EQUIVALENT CASH FLOWS
NO RESIDUAL VALUE

Soil Zone	Case	AECF ($/acre)		
		Total Res.	After Fin.	After Fin&Tax
Brown				
	1/2-1/2 vs 1/3-2/3	-1.48	-1.69	-1.35
	1/2-1/2 vs 1/4-3/4	-3.82	-4.10	-3.28
	1/3-2/3 vs 1/4-3/4	-2.35	-2.42	-1.93
Dark Brown				
	1/3-2/3 vs c/c	10.77	10.30	8.24
	1/4-3/4 vs c/c	9.93	9.48	7.59
	1/3-2/3 vs 1/4-3/4	0.83	0.79	0.63
Black (Northeast)				
	1/3-2/3 vs c/c	8.45	8.45	6.76
	1/4-3/4 vs c/c	5.46	5.46	4.37
	1/3-2/3 vs 1/4-3/4	2.99	2.99	2.39
Black (Central)				
	1/3-2/3 vs c/c	12.63	12.63	10.10
	1/4-3/4 vs c/c	11.65	11.65	9.32
	1/3-2/3 vs 1/4-3/4	0.98	0.98	0.78
Gray (Peace River)				
	1/3-2/3 vs c/c	5.58	5.58	4.46
	1/4-3/4 vs c/c	4.25	4.25	3.40
	1/3-2/3 vs 1/4-3/4	1.33	1.33	1.06

1. Based on a 5 per cent discount rate and a 9-year project.

TABLE 49

FINANCIAL ANALYSIS: SUMMERFALLOW REDUCTION[1], NET PRESENT VALUE
NO RESIDUAL VALUE

Soil Zone	Case	NPV ($/acre)		
		Total Res.	After Fin.	After Fin&Tax
Brown				
	1/2-1/2 vs 1/3-2/3	-10.50	-12.00	-9.59
	1/2-1/2 vs 1/4-3/4	-27.18	-29.18	-23.33
	1/3-2/3 vs 1/4-3/4	-16.68	-17.18	-13.74
Dark Brown				
	1/3-2/3 vs c/c	76.57	73.21	58.58
	1/4-3/4 vs c/c	70.56	67.38	53.92
	1/3-2/3 vs 1/4-3/4	5.89	5.62	4.50
Black (Northeast)				
	1/3-2/3 vs c/c	60.05	60.05	48.04
	1/4-3/4 vs c/c	38.80	38.80	31.04
	1/3-2/3 vs 1/4-3/4	21.25	21.25	17.00
Black (Central)				
	1/3-2/3 vs c/c	89.78	89.78	71.82
	1/4-3/4 vs c/c	82.82	82.82	66.25
	1/3-2/3 vs 1/4-3/4	6.96	6.96	5.57
Gray (Peace River)				
	1/3-2/3 vs c/c	39.63	39.63	31.70
	1/4-3/4 vs c/c	30.19	30.19	24.15
	1/3-2/3 vs 1/4-3/4	9.44	9.44	7.55

1. Based on a 5 per cent discount rate and a 9-year project.

TABLE 50

FINANCIAL ANALYSIS: SUMMERFALLOW REDUCTION[1], B/C RATIO
NO RESIDUAL VALUE

Soil Zone	Case	B/C (ratio)		
		Total Res.	After Fin.	After Fin&Tax
Brown				
	1/2-1/2 vs 1/3-2/3	0.87	0.86	0.88
	1/2-1/2 vs 1/4-3/4	0.79	0.79	0.82
	1/3-2/3 vs 1/4-3/4	0.67	0.67	0.72
Dark Brown				
	1/3-2/3 vs c/c	1.36	1.32	1.24
	1/4-3/4 vs c/c	1.48	1.43	1.32
	1/3-2/3 vs 1/4-3/4	1.09	1.08	1.06
Black (Northeast)				
	1/3-2/3 vs c/c	1.32	1.32	1.24
	1/4-3/4 vs c/c	1.29	1.29	1.22
	1/3-2/3 vs 1/4-3/4	1.40	1.40	1.30
Black (Central)				
	1/3-2/3 vs c/c	1.48	1.48	1.35
	1/4-3/4 vs c/c	1.62	1.62	1.44
	1/3-2/3 vs 1/4-3/4	1.13	1.13	1.10
Gray (Peace River)				
	1/3-2/3 vs c/c	1.23	1.23	1.18
	1/4-3/4 vs c/c	1.25	1.25	1.19
	1/3-2/3 vs 1/4-3/4	1.19	1.19	1.15

1. Based on a 5 per cent discount rate and a 9-year project.

TABLE 51

FINANCIAL ANALYSIS: SUMMERFALLOW REDUCTION[1],
ANNUAL EQUIVALENT CASH FLOWS
NO RESIDUAL VALUE
WITHOUT SUBSIDIES

Soil Zone	Case	AECF ($/acre)		
		Total Res.	After Fin.	After Fin&Tax
Brown				
	1/2-1/2 vs 1/3-2/3	-4.92	-5.45	-4.36
	1/2-1/2 vs 1/4-3/4	-11.40	-12.11	-9.68
	1/3-2/3 vs 1/4-3/4	-6.48	-6.66	-5.33
Dark Brown				
	1/3-2/3 vs c/c	9.65	9.18	7.34
	1/4-3/4 vs c/c	9.08	8.64	6.91
	1/3-2/3 vs 1/4-3/4	0.55	0.51	0.41
Black (Northeast)				
	1/3-2/3 vs c/c	7.22	7.22	5.78
	1/4-3/4 vs c/c	4.54	4.54	3.63
	1/3-2/3 vs 1/4-3/4	2.68	2.68	2.15
Black (Central)				
	1/3-2/3 vs c/c	11.31	11.31	9.05
	1/4-3/4 vs c/c	10.66	10.66	8.53
	1/3-2/3 vs 1/4-3/4	0.65	0.65	0.52
Gray (Peace River)				
	1/3-2/3 vs c/c	4.21	4.21	3.36
	1/4-3/4 vs c/c	3.22	3.22	2.58
	1/3-2/3 vs 1/4-3/4	0.99	0.99	0.79

1. Based on a 5 per cent discount rate and a 9-year project.

TABLE 52

FINANCIAL ANALYSIS: SUMMERFALLOW REDUCTION[1], NET PRESENT VALUE
NO RESIDUAL VALUE
WITHOUT SUBSIDIES

Soil Zone	Case	NPV ($/acre)		
		Total Res.	After Fin.	After Fin&Tax
Brown				
	1/2-1/2 vs 1/3-2/3	-13.99	-15.49	-12.39
	1/2-1/2 vs 1/4-3/4	-32.42	-34.42	-27.53
	1/3-2/3 vs 1/4-3/4	-18.43	-18.93	-15.14
Dark Brown				
	1/3-2/3 vs c/c	68.58	65.22	52.19
	1/4-3/4 vs c/c	64.57	61.39	49.13
	1/3-2/3 vs 1/4-3/4	3.89	3.62	2.90
Black (Northeast)				
	1/3-2/3 vs c/c	51.33	51.33	41.06
	1/4-3/4 vs c/c	32.26	32.26	25.81
	1/3-2/3 vs 1/4-3/4	19.07	19.07	15.26
Black (Central)				
	1/3-2/3 vs c/c	80.39	80.39	64.32
	1/4-3/4 vs c/c	75.78	75.78	60.62
	1/3-2/3 vs 1/4-3/4	4.62	4.62	3.69
Gray (Peace River)				
	1/3-2/3 vs c/c	29.89	29.89	23.91
	1/4-3/4 vs c/c	22.89	22.89	18.31
	1/3-2/3 vs 1/4-3/4	7.00	7.00	5.60

1. Based on a 5 per cent discount rate and a 9-year project.

TABLE 53

FINANCIAL ANALYSIS: SUMMERFALLOW REDUCTION[1], B/C RATIO
NO RESIDUAL VALUE
WITHOUT SUBSIDIES

Soil Zone	Case	B/C (ratio)		
		Total Res.	After Fin.	After Fin&Tax
Brown				
	1/2-1/2 vs 1/3-2/3	0.81	0.81	0.84
	1/2-1/2 vs 1/4-3/4	0.74	0.74	0.78
	1/3-2/3 vs 1/4-3/4	0.62	0.63	0.68
Dark Brown				
	1/3-2/3 vs c/c	1.33	1.30	1.22
	1/4-3/4 vs c/c	1.46	1.41	1.30
	1/3-2/3 vs 1/4-3/4	1.06	1.05	1.04
Black (Northeast)				
	1/3-2/3 vs c/c	1.29	1.29	1.22
	1/4-3/4 vs c/c	1.25	1.25	1.19
	1/3-2/3 vs 1/4-3/4	1.38	1.38	1.28
Black (Central)				
	1/3-2/3 vs c/c	1.45	1.45	1.33
	1/4-3/4 vs c/c	1.60	1.60	1.43
	1/3-2/3 vs 1/4-3/4	1.09	1.09	1.07
Gray (Peace River)				
	1/3-2/3 vs c/c	1.19	1.19	1.14
	1/4-3/4 vs c/c	1.20	1.20	1.15
	1/3-2/3 vs 1/4-3/4	1.15	1.15	1.11

1. Based on a 5 per cent discount rate and a 9-year project.

stubble yield reductions indicated the need for high management levels to ensure maximum possible stubble yields with reduction in summerfallow acreage. Fluctuations in yields and thus revenues, as reflected by yield series data did have an impact on returns, but all previously feasible cropping alternatives remained feasible. This indicated that even under fluctuating yields, continuous cropping could be economically feasible. A more frequent machinery replacement policy, however, did make more intensive cropping unattractive on Black (Northeast) and Gray (Peace River) zones. The decision related to machinery replacement policy is partly an individual manager's decision. A more frequent or faster replacement policy creates higher investment costs and thus would have an impact on the net revenue stream of any cropping system, whether intensive or extensive.

The most likely crop rotation change was chosen for each soil zone as follows:

Brown	from 1/2-1/2 to 1/3-2/3;
Dark Brown	from 1/3-2/3 to C/C;
Black (Central)	from 1/4-3/4 to C/C;
Black (Northeast)	from 1/4-3/4 to C/C; and
Gray (Peace River)	from 1/4-3/4 to C/C.

Summerfallow reduction was financially feasible in all soil zones but Brown. The results were fairly stable to sensitivity tests. The financial returns to the farmers are fairly small relative to the additional time and management required to farm 200 or more acres annually. The financial AECF's are only marginally higher than the economic AECF's, indicating that the transfer payments to and from the farmers almost balance each other. Removal of subsidies reduced net returns by 10 to 25 per cent. If summerfallow reduction is to be promoted as either a means for increasing production or as a soil conservation practice, perhaps financial incentives are required. These could be similar to those for land improvement or reclamation practices, whereby a grant, subsidy or rebate is provided. Apart from renumeration, there is the restriction placed on increased production by quotas. This will also have to be taken into account in any incentive package for summerfallow reduction.

8. PRAIRIE AND WOODLAND RANGE IMPROVEMENTS

8.1 Objectives

(i)To determine the economics of rangeland improvement through clearing, breaking and seeding woodland and reseeding prairie range.

(ii)To evaluate the financial feasibility of prairie and woodland range improvement.

8.2 Methodology and Assumptions

8.2.1 Economic Analysis

To determine the on-farm benefits and costs of rangeland improvement, the following methods and assumptions were used:

(i)The method of analysis and reporting results are in the Introduction.

(ii)Analysis was based on a feeder operation with 150 acres of range to be improved and intensively managed. Clearing and development of woodland was done over three years and reseeding prairie range over one year. Both investments were based on a 20-year life.

(iii)Per acre range improvement costs are given in Table 54.

(iv)Feeder purchase costs and annual production costs (buying, pasturing and marketing) are given in Table 55.

(v)Grazing lost in animal unit months (AUM's) was treated as an annual cost during improvement only.

TABLE 54

RANGELAND IMPROVEMENT COSTS[1]

Item	Prairie to Tame	Woodland to Pasture
	($/acre)	
Clearing and Piling	-	90.00
Breaking	43.75	43.75
Working Down	-	78.75
Seeding	25.00	25.00
Fertilizing[2]	-	37.81
Fencing[3]	-	30.00
Total	70.00	305.31

1. Alberta Agriculture and Energy and Natural Resources (publications and personal communication).
2. Fertilizing every year: at 70 lbs N, 15 lbs P_2O_5 (including S), and 7 lbs K_2O per acre. Based on consultation with the Soil and Feed Testing Laboratory.
3. Fencing based on $4 520 for 150 acres.

TABLE 55

CATTLE COSTS

Item	Cost ($/head)
Cattle Purchase[1]	$450.00
Fees[2]	14.25
Veterinarian Costs, Salt[3]	5.00
Trucking Costs[4]	20.00
Total Production Costs	489.25

1. 600 lbs at $0.75/lb: Statistics Branch, Alberta Agriculture, (1982).
2. Includes commission, insurance, brands, inspection and yard fees: Economic Services Division, Alberta Agriculture and Edmonton Stock Yard.
3. Production Economics Branch CRD No. 259.
4. Alberta Trucking Association rates.

(vi)Production was valued in AUM's based on the following:

a] One AUM = forage required by one animal unit (AU) for one month
One AU is equivalent to one mature cow weighing 1 000 lbs with or without calf at foot.
One AUM = 1 430 lbs forage (dry matter) -45 per cent carryover of 643 lbs = 787 lbs forage available to be eaten;

b] Conversion Ratio = 12:1 (forage:beef)
One AUM = 787/12 = 65.58 lbs (beef); and

c] Selling price of feeders = $0.706/lbs[1]
Value of one AUM (at scale) = 65.58 x 0.706 = $46.30.

(vii)Benefits were valued by the increase in AUM's per acre as shown in Table 56. Fertilizing was assumed for woodland range improvement but not for prairie range improvement; hence the difference in carrying capacities on Black soils for the two sub-options.

(viii)Production, measured in yearlings on pasture for 5 months, was based on the following:

a] No. of AU's on pasture for 5 months = (AUM's x acres)/5
e.g. 3.5 x 150/5 = 105 AU's or yearlings[2].

(ix)The purchase of cattle was treated as an annual operating cost and the sale of inventory as an annual revenue, to reflect the spring and fall price differential.

(x)Sensitivity analysis was done for changes in a number of assumptions.

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1. Statistics Branch, Alberta Agriculture (1982).

2. Because of increasing forage requirements per yearling during the grazing period, the number of feeders on pasture was limited by requirements at the end of the period, i.e. 1 AUM per feeder instead of 0.7 AUM per feeder.

TABLE 56

CARRYING CAPACITIES ON PRAIRIE AND WOODLAND RANGE

Soil Zone	Carrying Capacities		
	Unimproved Range[1]	Improved Range[2]	Increase
	(AUM's/acre)		
Prairie Range			
Brown	0.20	0.40	0.20
Dark Brown	0.35	1.05	0.70
Black	0.50	1.50	1.00
Woodland Range			
Black	0.25	2.00	1.75
Gray	0.20	2.00	1.80

Sources: Range Pastures in Alberta, Alberta Agriculture and E.N.R., 1979; Seeding Pastures in Alberta, Alberta Agriculture, 1975; personal communication with R.A. Wroe, Field Crops Branch, Alberta Agriculture, 1984.

1. These represent native range conditions or pasture in poor condition.
2. These represent pasture in good condition.

8.2.2 Financial Analysis

To determine whether existing incentives make prairie and woodland range improvement feasible for the agricultural producer, the following transfer payments were measured:

Inflows

(i) Producers who improve their soil are eligible for a land improvement grant. This grant is received annually for five years. Each annual receipt is the lowest of either $700, 7 per cent of the investment or the interest payments on the investment.[1]

1. Loree, Wilson J., Assistance Available for Alberta Farmers, Alberta Agriculture, Agdex 871, 1985.

(ii)It was assumed that all capital investments were financed through loans.

(iii)Residual values were assumed to be equal to land improvement costs. For sensitivity, they were also tested at a zero value.

(iv)Sensitivity analysis was done excluding land improvement grants.

Outflows

(v)Loans were capitalized over 10 years at a 13 per cent interest rate.

(vi)Operating capital was required for the five months cattle were grazed, calculated at a rate of 13 per cent yearly (monthly compounding) or 5.2 per cent for five months.

8.3 Results

8.3.1 Economic Analysis

Results are summarized in Table 57. The benefits from reseeding prairie range increased from the Brown, through the Dark Brown to the Black soil zone, reflecting increases in carrying capacities. By converting woodland to pasture, the benefits were quite similar on the Black soils and Gray, reflecting similar carrying capacities.

Under the assumptions and method of analysis adopted, investment in breaking and reseeding prairie range was shown to be economically feasible. Clearing, breaking and seeding woodland, however, was not feasible. Rangeland improvement is capital intensive; the per acre discounted investment cost of reseeding prairie range and converting woodland to pasture being $65 and $300 respectively. In addition to actual land improvement costs there were cattle purchase costs which increased the initial outlay in the first few years to between $133 and $233 per acre on prairie range and $660 per acre on woodland range.

TABLE 57

ECONOMIC PERFORMANCE MEASURES FOR RANGELAND IMPROVEMENT INVESTMENTS[1]

Soil Zone	Increase in Carrying Capacity (AUM's/acre)	DIC[2]	NPV	AECF	B/C	IRR
		----------($/acre)---------			(ratio)	(%)
Prairie Range[3]						
Brown	0.20	65	4	0.29	1.01	6
Dark Brown	0.70	65	189	15.16	1.22	28
Black	1.00	65	298	23.91	1.25	38
Woodland Range[4]						
Black	1.75	279	-108	-8.65	0.95	0
Gray	1.80	279	-86	-6.93	0.96	1

1. Discount rate of 5 per cent.
2. Purchase cost of cattle not included.
3. Break and reseed native range.
4. Clear, break, seed, fertilize and fence woodland.

The NPV's for reseeding prairie range varied from $4 per acre on Brown soils to $298 per acre on Black. AECF's ranged from less than $1 to $24 per acre and B/C ratios from 1.01 to 1.25. The IRR's were 6 per cent on Brown, 28 per cent on Dark Brown and 38 per cent on Black. The NPV's of woodland range improvement were negative, being -$108 per acre on Black soils and -$86 per acre on Gray; AECF's were -$9 and -$7 per acre. The B/C ratios were 0.95 and 0.96 and the IRR's were 0 and 1 per cent respectively.

Sensitivity analysis indicated that the feasibility of range improvement investments was fairly responsive to changes in revenue that could result from price changes or changes in management, as represented by feed conversion ratios. Changes of 10 to 20 per cent in revenue produced drastic changes in the NPV's of reseeding prairie range and of woodland improvement. The investment in prairie range improvement would become infeasible with 20 per cent reductions in revenue.

Changes of 10 per cent in both capital and operating costs caused major changes in NPV's for both woodland range improvement and for prairie range improvement. A 10 per cent increase in total (range improvement) costs caused Brown soils to become infeasible and NPV's in Dark Brown and Black soils to decrease by almost 50 per cent. Prairie range improvement became marginal or infeasible at 20 per cent increases in total costs. Woodland range improvement became more infeasible with any increase in costs of production. The feasibility of the investments was less sensitive to changes such as 10 per cent variations in capital costs. Prairie improvement on Black and Dark Brown soils were the only cases in which a reinvestment in breaking and seeding still yielded positive NPV's. When a 10 per cent reduction in revenue was added to the reinvestment scenario, the projects became fairly marginal, with reseeding on Brown soils becoming infeasible.

Increases in AUM's for both prairie and woodland range improvement resulted in increased NPV's and AECF's. In the case of woodland improvement, the increases were quite dramatic. AUM's were increased from 1.75 to 3.25; and 1.80 to 3.30 for Black and Gray respectively, which caused increases of 6 to 7 times in NPV's, taking them from negative to high positive values. On Black woodland soils, range improvement with decreased AUM's and without fertilizer yielded higher (positive) results than the base case with fertilizer and higher AUM's. Thus, it was shown that in this case it did not pay to apply fertilizer since the costs were greater than the incremental revenue resulting from the increased carrying capacity.

The results were sensitive to changes in discount rates. For reseeding prairie range on Black and Dark Brown soils, NPV's changed between 23 per cent and 45 per cent, with a 2 per cent change in the discount rate. On Brown soils the NPV fell by 275 per cent to a negative value at the 7 per cent rate, and rose by 350 per cent at the 3 per cent discount rate. Under woodland range improvement the already negative results changed less dramatically, by only 20 to 29 per cent. On reseeded Brown soils, the B/C ratio fell below 1 at the 7 per cent discount rate. The inclusion of a residual value for land increased all NPV's and AECF's. On reseeded Black and Dark Brown soils the increases were slightly larger than those caused by a 20 per cent decrease in

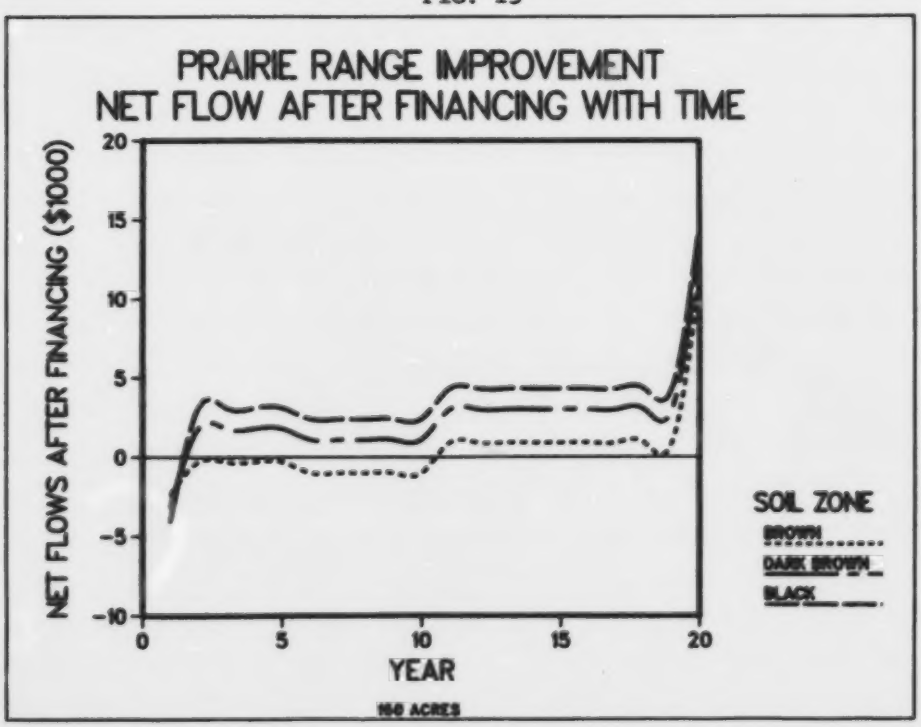
capital costs. In these cases, B/C ratios and IRR's did not change substantially. On reseeded Brown soils there was a significant increase in the NPV; the AECF and IRR also increased, with inclusion of the residual value. Black soils and Gray converted from woodland to pasture, showed dramatic increases in all indicators, making these options feasible. Results of sensitivity analysis are provided in Appendix VII.

8.3.2 Financial Analysis

Prairie Range Improvement

For both the Black and Dark Brown soil zones negative cash flows occurred only in the first year, in the order of $4 to $88 per acre ($625 to $13 000 per 150-acre unit), depending on the level of analysis (see Figure 15). In the case of the Brown soil zone the addition of a financing package generated negative flows between $2.31 and $15.70 per acre ($346 to $2 355 per 150-acre unit). These flows occurred in year 1 through 10 at a 20 per cent tax rate. The first-year flow became positive and was valued at $0.45 per acre.

FIG. 15



From Table 58 it is seen that prairie range improvement would be feasible in all soil zones examined. The Black soils were found to optimize the feasibility while the Brown soils were the least feasible. As in the case of some other alternatives the level of analysis did not change the ranking. After financing, the AECF's for prairie improvement were reduced by 20 per cent on Black and 78 per cent on Brown. The exclusion of residual values did not significantly change the results of this analysis for Black and Dark Brown soils but made improvement on Brown infeasible (see Table 59). Similarly, the exclusion of subsidies reduced net returns on Black soils by 8 per cent and on Dark Brown soils by 12 per cent. However, the exclusion of land improvement grants did make the project infeasible on the Brown soils (see Table 60). On Brown soils, however, prairie range improvement became infeasible. Similarly, at 7 per cent and 10 per cent discount rates, prairie range improvement was infeasible on Brown soils with residual value included and infeasible at all discount rates when no residual value was included. The investments on Black and Dark Brown soils were feasible in all cases (see Appendix VII).

Woodland Range Improvement

For both the Black and Gray soil zones substantial negative flows occurred in the first three years, ranging from $95 to $135 per acre ($14 000 to $20 000 per 150-acre unit). The inclusion of financing distributed these negative flows within the first twelve years of the project in the order of $4 to $52 per acre or $550 to $7 786 per 150-acre unit (Figure 16). The further inclusion of taxes changed the distribution of these negative flows to years two through twelve and reduced the upper limit of the range to $44 per acre ($6 656 per 150-acre unit).

The analysis of this alternative generated results which showed prairie range improvement to have higher AECF's than woodland range improvement. B/C ratios were very different, with the lowest for prairie range improvement being equal to the highest for woodland range

TABLE 58

FINANCIAL ANALYSIS: PRAIRIE RANGE IMPROVEMENT
WITH RESIDUAL VALUE

	AECF ($/ac)		
	Total Resources	After Financing	After Fin & Tax
Brown	2.36	0.52	0.87
Dark Brown	17.25	13.25	11.04
Black	25.99	20.69	17.00

	NPV ($/ac)		
	Total Resources	After Financing	After Fin & Tax
Brown	29.45	6.53	10.79
Dark Brown	214.95	165.09	137.64
Black	323.86	257.84	211.85

	B/C (ratio)		
	Total Resources	After Financing	After Fin & Tax
Brown	1.10	1.01	1.02
Dark Brown	1.25	1.10	1.08
Black	1.27	1.11	1.09

1. Based on a 5 per cent discount rate and a 20-year project.

TABLE 59

FINANCIAL ANALYSIS: PRAIRIE RANGE IMPROVEMENT[1]
NO RESIDUAL VALUE

	AECF ($/ac)		
	Total Resources	After Financing	After Fin & Tax
Brown	0.28	-1.56	-1.00
Dark Brown	15.17	11.17	9.17
Black	23.91	18.61	15.13

	NPV ($/ac)		
	Total Resources	After Financing	After Fin & Tax
Brown	3.54	-19.39	-12.53
Dark Brown	189.04	139.18	114.32
Black	297.95	231.94	188.53

	B/C (ratio)		
	Total Resources	After Financing	After Fin & Tax
Brown	1.01	0.97	0.98
Dark Brown	1.22	1.08	1.07
Black	1.25	1.10	1.08

1. Based on a 5 per cent discount rate and a 20-year project.

TABLE 60

FINANCIAL ANALYSIS: PRAIRIE RANGE IMPROVEMENT
WITH RESIDUAL VALUE
WITHOUT SUBSIDIES

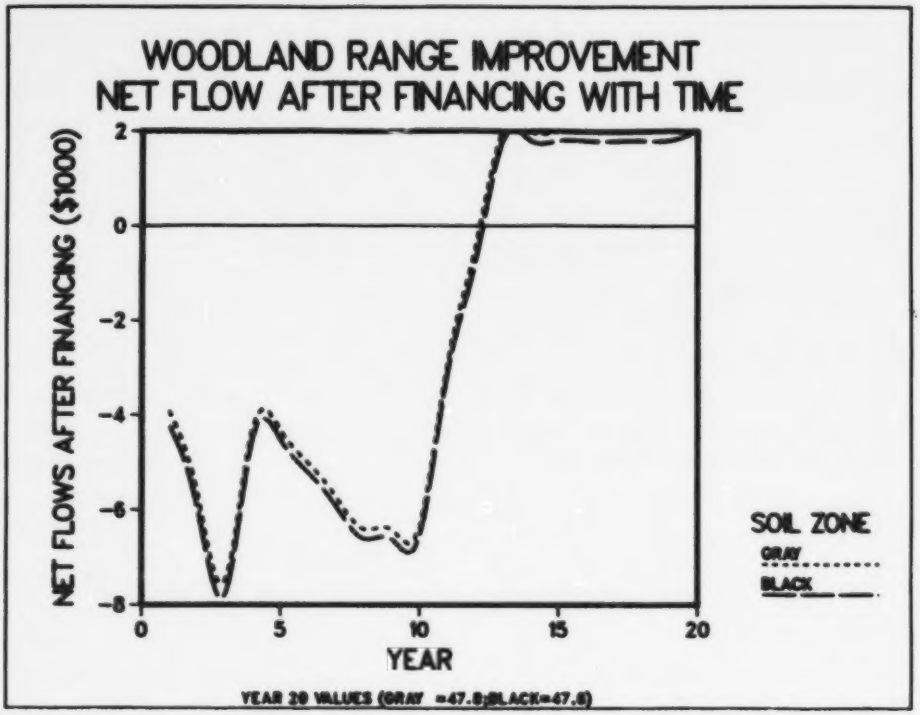
	AECF ($/ac)		
	Total Resources	After Financing	After Fin & Tax
Brown	2.36	-1.09	-0.43
Dark Brown	17.25	11.63	9.75
Black	25.99	19.07	15.70

	NPV ($/ac)		
	Total Resources	After Financing	After Fin & Tax
Brown	29.45	-13.68	-5.37
Dark Brown	214.95	144.88	121.48
Black	323.86	237.64	195.68

	B/C (ratio)		
	Total Resources	After Financing	After Fin & Tax
Brown	1.10	0.98	0.99
Dark Brown	1.25	1.08	1.07
Black	1.27	1.10	1.08

1. Based on a 5 per cent discount rate and a 20-year project.

FIG. 16



improvement. In fact, only at the total resources level of analysis did woodland range improvement have B/C ratios greater than 1.0 (see Table 61). After financing, AECF's fell drastically becoming negative on both Gray and Black soils. At a 20 per cent marginal tax rate the AECF's recovered slightly, but remained negative. Removal of residual land values or of land improvement grants only made the results worse (see Tables 62 and 63). A 3 per cent discount rate did not affect the outcome of the analysis (see Appendix VII).

8.4 Conclusion

In conclusion, the highest values for all economic measures for prairie range improvement were obtained on Black soils, reflecting the highest total benefits as well as the highest returns per dollar invested. This is partly due to the inherent productivity of Black

TABLE 61

FINANCIAL ANALYSIS: WOODLAND RANGE IMPROVEMENT
WITH RESIDUAL VALUE

	AECF ($/ac)		
	Total Resources	After Financing	After Fin & Tax
Black	0.58	-12.23	-7.84
Gray	2.30	-10.70	-6.62

	NPV ($/ac)		
	Total Resources	After Financing	After Fin & Tax
Black	7.29	-152.43	-97.75
Gray	28.62	-133.38	-82.51

	B/C (ratio)		
	Total Resources	After Financing	After Fin & Tax
Black	1.00	0.97	0.98
Gray	1.01	0.97	0.98

1. Based on a 5 per cent discount rate and a 20-year project.

TABLE 62

FINANCIAL ANALYSIS: WOODLAND RANGE IMPROVEMENT
NO RESIDUAL VALUE

	AECF ($/ac)		
	Total Resources	After Financing	After Fin & Tax
Black	-8.65	-21.47	-16.16
Gray	-6.94	-19.94	-14.93

	NPV ($/ac)		
	Total Resources	After Financing	After Fin & Tax
Black	-107.83	-267.55	-201.35
Gray	-86.50	-248.50	-186.11

	B/C (ratio)		
	Total Resources	After Financing	After Fin & Tax
Black	0.95	0.94	0.95
Gray	0.96	0.94	0.96

1. Based on a 5 per cent discount rate and a 20-year project.

TABLE 63

FINANCIAL ANALYSIS: WOODLAND RANGE IMPROVEMENT
WITH RESIDUAL VALUE
WITHOUT SUBSIDIES

	AECF ($/ac)		
	Total Resources	After Financing	After Fin & Tax
Black	0.58	-16.87	-11.55
Gray	2.30	-15.34	-10.33

	NPV ($/ac)		
	Total Resources	After Financing	After Fin & Tax
Black	7.29	-210.21	-143.96
Gray	28.62	-191.15	-128.72

	B/C (ratio)		
	Total Resources	After Financing	After Fin & Tax
Black	1.00	0.95	0.97
Gray	1.01	0.96	0.97

1. Based on a 5 per cent discount rate and a 20-year project.

soils and the increase in carrying capacity with improvements, relative to other soil zones. Improvement was not feasible on Brown soils without a land improvement grant. Investment costs were higher for woodland range improvement because of the additional clearing costs. Prairie range improvement was shown to be superior to woodland range improvement at every level of analysis. In fact, woodland range improvement was shown to be infeasible on both Black and Gray soils after a financing package was added both with or without subsidies. Prairie range improvement on Brown soils can be considered a marginal investment, particularly when the results of sensitivity analysis are taken into consideration. Results for range improvement on Black and Dark Brown soils were quite stable to sensitivity analysis.

Financial AECF's were somewhat lower than the economic AECF's, indicating that transfer payments made by the farmer to the rest of the economy were greater than those received by the rancher in the form of grants, rebates and other subsidies. To make range improvement as financially attractive for the rancher as for the economy, additional incentives would be required. These could be in the form of fertilizer subsidies or possibly operating loan interest rebates, particularly for the annual cost of purchasing feeders.

9. RANGE CONVERSION[1]

9.1 Objectives

(i)To determine the farm-level consequences of converting native range to annual cropland.

(ii)To evaluate the financial feasibility of range conversion, on four soil zones in Alberta.

9.2 Methodology and Assumptions

9.2.1 Economic Analysis

To determine the on-farm benefits and costs of rangeland conversion, the following methods and assumptions were used:

(i)A whole-farm computer model that simulates the major strategies for beef, forage, and grain production in western Canada was used in the analysis.[2] A complete change in the management system was adopted to accommodate this conversion.

(ii)Changes in net farm income were determined and marginal economic analysis employed to evaluate the investments in rangeland conversion, based on a ten-year period. Input costs, crop prices, yields, discount rates, and method of result reporting outlined in the Introduction were used.

(iii)Typical base cattle-grain farms were determined for each of the major soil zones.[3] These are given in Table 64.

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1. This chapter, in part, was derived from a study done by Kurt Klein of Klein Economic Consulting Ltd. for Alberta Agriculture. The financial analysis was done entirely by the Production and Resource Economics Branch, Alberta Agriculture.

2. Sonntag and Klein, 1979.

3. Based on Statistics Canada, Census of Agriculture data.

TABLE 64

TYPICAL BASE CATTLE-GRAIN FARMS BY SOIL ZONE

Soil Zone	System	Cows	Calves	Range	Pasture	Hayland	Cropland	Rotation
		--(number)--		----------(acres)----------				--(yrs)-
Brown	Cow/Calf	75	-	1 435	450	220	490	2
Dark Brown	Cow/Calf/ Feeder	50	38	711	150	106	270	3
Black	Cow/Calf/ Stocker	40	30	1 041	50	78	198	3
Gray	Cow/Calf/ Long Yearling	35	25	1 487	152	122	160	3

(iv)Analysis was based on converting 20 per cent of existing native pasture to cropland. The cost of converting native range to annual cropland was $45 per acre ($25 for breaking and $20 for working down).[1] The discounted investment cost (DIC) reported included breaking and working down plus the additional investment in machinery. A correction factor was adopted to account for machinery replacement that would have occurred later if there were no conversion.

(v)Two herd-management strategies were considered: one where the size of the basic herd was maintained through the additional use of straw, residue products, purchased hay and feed grains; and the other where herd size was adjusted to the reduced pasture supply. The latter was chosen as the more appropriate.

(vi)A complement of used machinery and equipment was assumed.

(vii)Sensitivity analysis was done for 10 and 20 per cent changes in costs and revenues. Sensitivity analysis was also done using 3 and 7 per cent real discount rates and with a residual value included.

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1. Andruchow, L., Farm Machinery Costs Manual (1982), Alberta Agriculture.

9.2.2 Financial Analysis

To determine whether existing incentives make investment in rangeland improvement feasible for the farmer, the following transfer payments were measured:

Inflows

(i) Producers who invest in land improvement projects are eligible for a land improvement grant. This grant is received annually for five years. Each annual receipt is the lowest of either $700, 7 per cent of the investment or the interest payments of the investment.[1]

(ii) Equity was assumed to be zero on any capital investment required, that is, the investment required by this project was assumed to be financed totally by borrowings. Only incremental costs were shown for earlier machinery purchases as in the economic analysis.

(iii) Residual value was assumed to be equal to the sum of all land improvement costs. A value of zero was used as a sensitivity.

(iv) Western Grain Stabilization (WGS) benefits were assumed to be equal to WGS payments; therefore they were not included.

(v) All equipment was assumed to be salvaged in the last year of the project and valued at its undepreciated value.

(vi) Crop insurance claims were assumed to be twice the amount of the crop insurance payments, based on the federal government subsidization of the program.[2]

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1. Loree, Wilson J., Assistance Available for Alberta Farmers, Alberta Agriculture, Agdex 871, 1985.

2. Alberta Hail and Crop Insurance Corporation, 16th Annual Report; year ended March 31, 1984.

(vii)Sensitivity analysis was done excluding crop insurance subsidies and land improvement grants.

Outflows

(viii)The interest rate used for loans was 13 per cent, with a repayment period of 10 years.

(ix)The producer was assumed to pay off all outstanding loans at the end of the project; thus a residual capital repayment was determined.

(x)Income tax was calculated based on a marginal tax rate of 20 per cent, with sensitivity at 30 per cent.

(xi)Capital cost allowance for tax purposes was calculated using a declining balance at a rate of 15 per cent for self-propelled equipment and 10 per cent for tillage equipment.

(xii)Crop insurance payments were calculated based on soil zone, land class, crop mix and 60 per cent coverage with the high price alternative. These estimates were derived using information supplied by the Hail and Crop Insurance Corporation. In each soil zone a representative county or municipality was chosen to provide an estimate of the percentages of A, B, C, D and E land.

9.3 Results

9.3.1 Economic Analysis

The discounted investment costs (DIC); the net present value (NPV); annual equivalent cash flow (AECF); and benefit cost ratio (B/C) resulting from a 20 per cent conversion of native range to cropland are provided in Table 65. The results of this analysis indicated that the conversion of rangeland to annual cropland is economically feasible under the specific assumptions used and the method of analysis employed in the study.

TABLE 65

ECONOMIC ANALYSIS FOR CONVERSION OF RANGELAND TO CROPLAND

Soil Zone	Increased Cropland	20% Conversion Reduced Herd Size			
		DIC	NPV	AECF	B/C
	(acres)	--------($/ac)---------			(ratio)
Brown	288	52	226	29	2.04
Dark Brown	144	173	333	43	2.06
Black	208	78	310	40	1.82
Gray	296	88	260	34	1.95

DIC's ranged from $52 to $173 per acre. Higher costs reflected earlier machinery replacements or fewer acres converted (therefore higher machinery costs per acre). The AECF's on the Brown and Gray soils were $29 and $34 per acre respectively, with the B/C ratio being slightly higher on the Brown soil. On the Black and Gray soils, benefits ranged from 18 per cent to 48 per cent higher than on the other soils. B/C ratios ranged from 1.82 to 2.06 for all soil zones.

These variations reflected differences in crop yields and carrying capacities between soil zones and the relative efficiencies between crop and cattle enterprises. It would appear that where physically feasible, conversion of range to cropland on the four soil zones would be economically feasible.

Variations in the discount rate to 3 and 7 per cent produced 12 to 15 per cent changes in NPV's. B/C ratios all remained above 1.0 even at the 7 per cent discount rate. IRR's were greater than 10 per cent. Residual values increased AECF's by 8 to 10 per cent and B/C ratios by about 0.06 to 0.15. No major changes in returns were produced by 10 and 20 per cent increases in costs but the same percentage decreases in returns caused significant decreases in all indicators. At the 20 per cent level, Brown and Dark Brown soils showed B/C ratios below 1.0. Details of sensitivity analysis are given in Appendix VIII.

9.3.2 Financial Analysis

Negative cash flows occurred in the first year (before financing) in the order of $13 to $44 per acre. A larger negative flow also occurred (year 5 or later) where a major machinery purchase was made. Cash flows (after financing) were always positive, except for Gray soils during the first year when they were -$17 per acre (see Figure 17). When a residual value was excluded, the flow in the last year was sharply reduced by $45 per acre.

From Table 66 it is shown that all cases were financially feasible, with the Dark Brown and Black soil zones offering the best investment opportunities. The level of analysis did not affect this ranking substantially. The exclusion of residual values did not make any cases infeasible, though it did reduce the values for all soil zones (see Table 67). Similarly, net returns were reduced by the exclusion of subsidies

FIG. 17

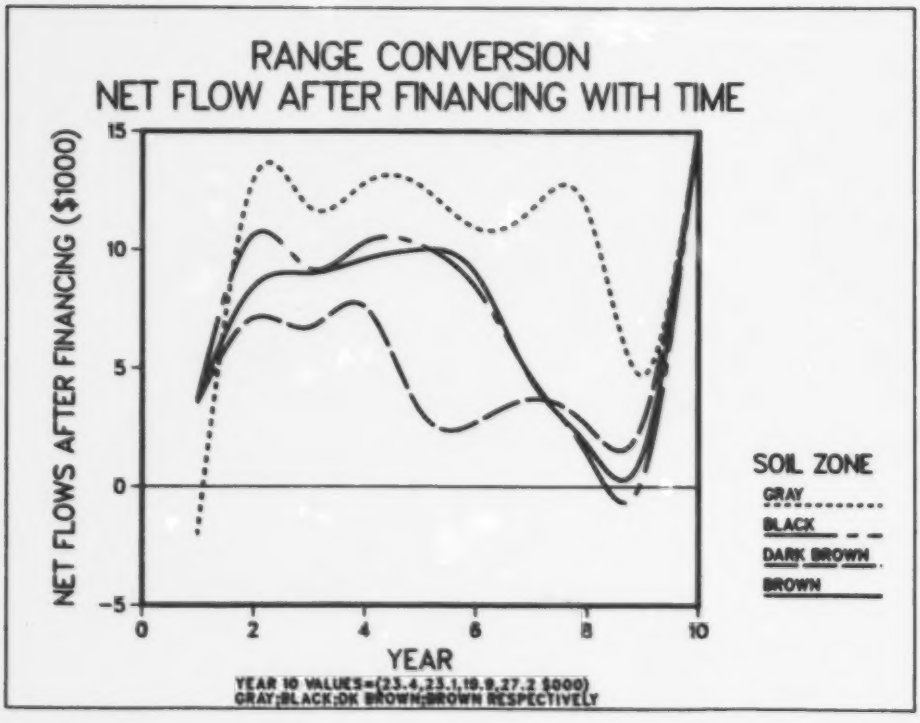

TABLE 66

FINANCIAL ANALYSIS: RANGE CONVERSION[1]
WITH RESIDUAL VALUE

	AECF ($/ac)		
	Total Resources	After Financing	After Fin & Tax
Brown	36.16	28.45	24.91
Dark Brown	50.26	41.31	35.53
Black	48.45	38.76	33.81
Gray	41.54	35.93	30.65

	NPV ($/ac)		
	Total Resources	After Financing	After Fin & Tax
Brown	279.20	219.67	192.39
Dark Brown	388.06	319.00	274.32
Black	374.10	299.29	261.06
Gray	320.78	277.47	236.64

	B/C (ratio)		
	Total Resources	After Financing	After Fin & Tax
Brown	2.16	1.48	1.39
Dark Brown	2.15	1.56	1.45
Black	1.93	1.44	1.36
Gray	2.09	1.57	1.44

1. Based on a 5 per cent discount rate and a 9-year project.

TABLE 67

FINANCIAL ANALYSIS: RANGE CONVERSION[1]
NO RESIDUAL VALUE

	AECF ($/ac)		
	Total Resources	After Financing	After Fin & Tax
Brown	32.58	24.87	21.69
Dark Brown	46.68	37.73	32.31
Black	44.87	35.18	30.59
Gray	37.96	32.36	27.43

	NPV ($/ac)		
	Total Resources	After Financing	After Fin & Tax
Brown	251.58	192.04	167.52
Dark Brown	360.44	291.37	249.46
Black	346.48	271.66	236.20
Gray	293.15	249.85	211.78

	B/C (ratio)		
	Total Resources	After Financing	After Fin & Tax
Brown	2.05	1.42	1.34
Dark Brown	2.07	1.52	1.41
Black	1.86	1.40	1.33
Gray	1.99	1.51	1.40

1. Based on a 5 per cent discount rate and a 9-year project.

by between 12 and 20 per cent (see Table 68). Appendix VII shows that changing the discount rate to 3 per cent or 7 per cent or increasing the tax rate from 20 per cent to 30 per cent did not affect feasibility in any zones.

9.4 Conclusion

The conversion of rangeland to cropland was shown to be economically feasible under the assumptions adopted in this study. Economic and financial results were quite similar, indicating that transfer payments to and from the producer were fairly well balanced. The removal of subsidies reduced net returns to the farmer by 12 to 20 per cent. The ranking by soil zones were similar in the economic and financial analysis, with Brown and Gray having slightly lower AECF's than Black and Dark Brown. Environmental and conservation factors which may mitigate against such conversion have not been taken into account.

TABLE 68

FINANCIAL ANALYSIS: RANGE CONVERSION[1]
WITH RESIDUAL VALUE
WITHOUT SUBSIDIES

	AECF ($/ac)		
	Total Resources	After Financing	After Fin & Tax
Brown	31.85	24.14	21.46
Dark Brown	45.54	36.60	31.75
Black	43.73	34.04	30.04
Gray	37.27	31.66	27.23

	NPV ($/ac)		
	Total Resources	After Financing	After Fin & Tax
Brown	245.90	186.37	165.74
Dark Brown	351.65	282.58	245.19
Black	337.69	262.87	231.93
Gray	287.76	244.46	210.23

	B/C (ratio)		
	Total Resources	After Financing	After Fin & Tax
Brown	2.13	1.42	1.36
Dark Brown	2.12	1.52	1.42
Black	1.89	1.40	1.33
Gray	2.06	1.52	1.42

1. Based on a 5 per cent discount rate and a 9-year project.

10. WOODLAND CONVERSION

10.1 Objectives

(i)To determine the economic feasibility of converting woodland to cropland on existing farms.

(ii)To evaluate the financial feasibility of woodland conversion on two soil zones of Alberta.

10.2 Methodology and Assumptions

10.2.1 Economic Analysis

The following methods and assumptions were made for the purpose of evaluating the benefits and costs associated with woodland conversion:

(i)The analytic methods and system of reporting results; assumptions relating to farm size, machinery and building investment; crop mix, crop yields and prices, and production inputs; and management practices are as outlined in the Introduction, except where otherwise indicated.

(ii)A farm simulation model of dryland cereal and oilseed production in western Canada was modified for the purposes of this study and used in calculating farm revenue and production costs[1].

(iii)Two soil zones, Gray (Peace River) and Black (Central Region) were identified as having a significant number of farms with woodland suitable for cropping. For the Peace River Region (Gray), the cropped acres were increased from a base of 600 to 760 by converting woodland. In the Central Region (Black) 80 acres were converted

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1. Zentner, R.P., et al, "A Simulation Model for Dryland Crop production in the Canadian Prairies", Agricultural Systems, Vol. 3, No. 4., 1978. pp 241 - 257.

to increase the cropped acres from 600 to 680[1]. The agricultural benefits derived from the land prior to clearing were considered to be zero.

(iv)Per acre investment costs used for woodland conversion were:

Clearing and piling	$90.00
Breaking and working down (including rock-picking)	140.00
Total	$230.00

This investment cost was spread over a two-year development period.

(v)Benchmark (normal) yields were used in calculating revenue derived from the new cropland. Nevertheless, higher fertilizer rates and costs were shown in the first two years of cropping to achieve normal yields. These costs are shown in Table 69.

(vi)Analysis was carried out over a period of twenty-five years.

(vii)Sensitivity analysis was carried out to measure the impact of variations in certain assumptions.

10.2.2 Financial Analysis

To determine whether existing incentives make investment in woodland conversion feasible for the farmer, the following transfer payments were measured:

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1. These acreages are average acres wooded per farm in each soil zone in northern Alberta and are calculated from Statistics Canada, 1976 Census of Canada data.

TABLE 69

FERTILIZER APPLICATION RATES AND COSTS ON NEW BREAKING[1]

Year	Soil Zone	
	Black	Gray
Year One of Cropping	85 lbs N 32 lbs P $32.03/acre	80 lbs N 30 lbs P $30.11/acre
Year Two of Cropping	60 lbs N 27 lbs P $23.79/acre	55 lbs N 25 lbs P $21.87/acre
Subsequent Years		
- Stubble	38 lbs N 21 lbs P $16.13/acre	32.5 lbs N 18 lbs P $13.80/acre
- Fallow	14 lbs N 21 lbs P $9.50/acre	13 lbs N 18 lbs P $8.42/acre

1. Based on informed estimates from soil scientists, agrologists and farmers.

Inflows

(i) Producers who improve their soil in this way are eligible for a land improvement grant. This grant is received annually for five years. Each annual receipt is the lowest of either $700, 7 per cent of the investment or the interest payments on the investment.[1]

(ii) Equity was assumed to be zero on any capital investment required, that is, the investment required by this project was assumed to be financed totally by borrowings.

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1. Loree, Wilson J., Assistance Available for Alberta Farmers, Alberta Agriculture, Agdex 871, 1985.

(iii)Residual value was assumed to be equal to the sum of all land improvement costs. A value of zero was used as a sensitivity.

(iv)Western Grain Stabilization (WGS) benefits were assumed to be equal to WGS payments and therefore not included.

(v)Crop insurance claims were assumed to be twice the amount of the crop insurance payments, based on the federal government subsidization of the program.[1]

(vi)Sensitivity analysis was done excluding land improvement grants and crop insurance subsidies.

Outflows

(vii)Crop insurance payments were calculated based on soil zone, land class, crop mix and 60 per cent coverage with the high price alternative. These estimates were derived using information supplied by the Hail and Crop Insurance Corporation. In each soil zone a representative county or municipality was chosen to provide an estimate of the percentages of A, B, C, D and E land.

(viii)Loans were capitalized over 10 years at a 13 per cent interest rate.

(ix)The producer was assumed to pay off all outstanding loans at the end of the project; thus a residual capital repayment was determined.

(x)No changes in land taxes were assumed.

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1. Alberta Hail and Crop Insurance Corporation, 16th Annual Report; year ended March 31, 1984.

10.3 Results

10.3.1 Economic Analysis

Results expressed in terms of discounted investment costs (DIC), net present value (NPV) per acre, annual equivalent cash flow (AECF) per acre and benefit cost ratio (B/C) are given in Table 70.

TABLE 70

ECONOMIC PERFORMANCE MEASURES FOR WOODLAND CONVERSION

Soil Zone	Acres Converted	Final Cropped Acres	DIC[1]	NPV	AECF	B/C
			----------($/ac)----------			(ratio)
Black	80	680	214	710	50.39	1.68
Gray	160	760	214	307	21.77	1.39

1. Real discount rate of 5 per cent used.

Both cases examined showed positive net present values and benefit cost ratios greater than one, indicating that under the adopted method of analysis and assumptions, the conversion of woodland to cropland was economically feasible. The benefits derived from the conversion of woodland to cropland were greater on the Black soil zone than on the Gray, although conversion on the Black soils was restricted to a relatively small acreage. This difference reflected the higher productivity of the Black soils.

Although the projects were shown to be economically feasible, the initial outlay of capital required for clearing, breaking and working down the land to a proper seedbed condition was $230 per acre. This does not include a cost for the land owner's labour input on the development project. If the land owner's labour was valued, another $20 to $25 per

acre could be added to the cost of land development.[1]

Discounted investment costs for converting 160 acres of woodland to cropland on the Gray were $34 286 ($214 per acre). The net present value of this investment was $49 084 ($307 per acre) with a benefit-cost ratio of 1.39. The discounted investment costs for converting 80 acres of woodland to cropland in the Black soil zone were $17 143 ($214 per acre). The NPV of this investment was $56 812 ($710 per acre) and the B/C ratio was 1.68. Increasing or decreasing the cost of conversion by 10 per cent had only a minimal effect on results. In the Gray zone, the NPV varied with cost changes by $3 428 ($21.42 per acre), a change of ±7 per cent. Correspondingly, in the Black soil zone, the NPV varied by $1 714 ($21.42 per acre), a change of ±3 per cent. However, the feasibility of the conversion project was not affected greatly by 10 per cent changes in the initial investment cost. The inclusion of residual values increased the AECF's and B/C ratios substantially.

Sensitivity analysis indicated that conversion projects in both the Gray and the Black soil zones were quite responsive to changes in yields, crop prices and production costs. In the Gray soil zone, 10 per cent and 20 per cent changes in yields or prices caused changes of 36 and 72 per cent in the NPV's respectively, while 10 per cent and 20 per cent changes in production costs caused 18 per cent and 36 per cent changes in NPV's. In the Black soil zone, 10 per cent and 20 per cent changes in yields or prices caused variations of 25 per cent and 50 per cent in the NPV's, while 10 and 20 per cent changes in production costs caused 11 per cent and 23 per cent changes in the NPV's respectively. The NPV's, however, remained positive and the B/C ratios were greater than 1.0 in all cases for both soil zones. These results are important as they show the degree of vulnerability of converting woodland to cropland to such factors as varying yields and prices. Much of the land on existing farms that remains to be cleared has lower production capabilities (due to stoniness, topography, drainage or other problems) than the land currently being farmed. Long-term average yields as used in this study may not be achieved on this land. To some degree, a land-

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1. Visser, Peter. "A Study of Land Development Costs in the Peace River Region, 1984", Alberta Agriculture, 1984.

owner may compensate for the poor quality of the land by increasing the use of fertilizer. Sensitivity analysis is detailed in Appendix VIII.

10.3.2 Financial Analysis

The analysis of the cash flows showed that financing and, later, income taxes had the effect of flattening the extremes in cash flow. With total resources, there were negative cash flows in the order of $100 to $119 per acre in the first two years. Including financing reduced this range to -$10 to -$29 per acre (Figure 18). The further inclusion of taxes totally eliminated negative flows in the case of the Black soil zone and spread them over the first ten years for the Gray, with flows ranging from -$18 to $12.

From Table 71 it is seen that all cases were financially feasible, with results for the Black soil zone being double those of the Gray. The exclusion of residual values, (see Table 72) or of subsidies (see Table 73), changes in discount rates or increases in the tax rate did not make any of the cases infeasible (see Table 72 and Appendix IX).

FIG. 18

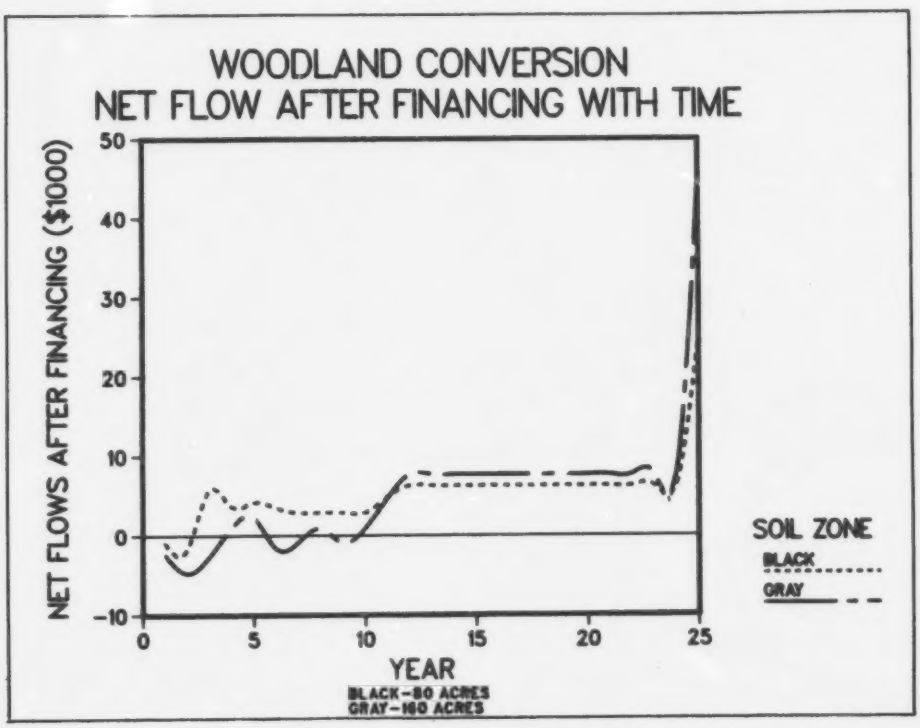

TABLE 71

FINANCIAL ANALYSIS: WOODLAND CONVERSION[1]
WITH RESIDUAL VALUE

Soil Zones	AECF ($/ac) Total Resources	AECF ($/ac) After Financing	AECF ($/ac) After Fin & Tax
Gray	30.70	25.81	21.82
Black	59.32	56.64	46.49

	NPV ($/ac) Total Resources	NPV ($/ac) After Financing	NPV ($/ac) After Fin & Tax
Gray	432.63	363.72	307.52
Black	836.00	798.30	655.18

	B/C (ratio) Total Resources	B/C (ratio) After Financing	B/C (ratio) After Fin & Tax
Gray	1.51	1.31	1.25
Black	1.76	1.56	1.42

1. Based on a 5 per cent discount rate and a 25-year project.

TABLE 72

FINANCIAL ANALYSIS: WOODLAND CONVERSION[1]
NO RESIDUAL VALUE

Soil Zones	AECF ($/ac) Total Resources	After Financing	After Fin & Tax
Gray	25.88	20.99	17.48
Black	54.50	51.82	42.15

	NPV ($/ac) Total Resources	After Financing	After Fin & Tax
Gray	364.71	295.80	246.39
Black	768.08	730.38	594.06

	B/C (ratio) Total Resources	After Financing	After Fin & Tax
Gray	1.43	1.25	1.20
Black	1.70	1.51	1.38

1. Based on a 5 per cent discount rate and a 25-year project.

TABLE 73

FINANCIAL ANALYSIS: WOODLAND CONVERSION[1]
WITH RESIDUAL VALUE
WITHOUT SUBSIDIES

Soil Zones	AECF ($/ac) Total Resources	After Financing	After Fin & Tax
Gray	26.59	19.07	16.43
Black	55.21	47.69	39.33
	NPV ($/ac)		
	Total Resources	After Financing	After Fin & Tax
Gray	374.71	268.81	231.59
Black	778.08	672.18	554.29
	B/C (ratio)		
	Total Resources	After Financing	After Fin & Tax
Gray	1.48	1.24	1.20
Black	1.75	1.49	1.37

1. Based on a 5 per cent discount rate and a 25-year project.

10.4 Conclusion

In summary, the conversion of woodland to cropland on existing farms was shown to be economically feasible on both the Gray and Black soils under the assumptions originally stated. Even under 20 per cent yield or price reductions, both projects remained economically feasible, although on the Gray, results were quite marginal. Because this alternative involves only a marginal increase in cultivated acreage, the investment cost was lower than that of expansion into the Green Area. B/C ratios and AECF's were higher for woodland conversion than for expansion. This alternative was also shown to be financially feasible for the farmer, with the Black soil zone being more attractive than the Gray.

Like most high investment alternatives, there were large negative cash flows in the early years of the project. These were reduced considerably after financing, but still implied the need for financing from savings or other sources. The financial AECF's after financing were slightly higher than the economic AECF's, however, reflecting slightly higher transfer payments from society to the producer than in the opposite direction. Exclusion of subsidies would reduce net returns on Gray soils by 25 per cent and on Black soils by 15 per cent. What may be needed is a redistribution of grants to the earlier years of the investment (for example, land improvement rebates concentrated in years one and two), to eliminate negative flows in these years.

The success of woodland conversion is greatly dependent on the soil and other physical conditions of the land to be cleared. No assumptions were made regarding isolation of such lands and additional costs of field operation, nor regarding lower than average production potential due to stoniness, topography or wet conditions. Cost increases of up to 20 per cent were shown to reduce return by up to 23 per cent (on Black) and 36 per cent (on Gray); 10 per cent reductions in yields had a similar impact. Returns fell more drastically with a 20 per cent decline in yields; by 50 per cent on Black and 72 per cent on Gray. Apart from retaining bushlands as shelter belts and for other reasons, there is the

deterrent of risk associated with such an investment. Where there is a chance of a 50 per cent or greater reduction in net returns associated with achieving yields 20 per cent below the average for the area, the producer may not have the incentive to undertake such an investment.

11. RECLAMATION OF SALINIZED LAND-DRYLAND

11.1 Objectives

(i)To determine the economics of control and reclamation of dryland saline soils through vegetative techniques.

(ii)To evaluate the financial feasibility of a vegetative reclamation method to reclaim a dryland saline seep in the Brown soil zone.

11.2 Methodology and Assumptions

11.2.1 Economic Analysis

The cause and control of dryland salinity can vary significantly from farm to farm and area to area, making economic analysis of reclamation practices difficult. Lack of data on reclamation rates and related crop yields for Alberta conditions compounds the problem. Several simplifying assumptions about these variables and others were made in this study. The benefits and cost of instituting vegetative reclamation of dryland saline soils in the Brown soil zone of southern Alberta were examined, using discount analysis.

(i)Analysis was based on a simulated dryland farming operation in Warner County (fringe area between Dark Brown and Brown soil zones), with 1 110 cultivated acres. Approximately 70 acres were assumed to be severely salinized.[1]

(ii)10-acre centrally located circular saline seep on a quarter section was assumed for ease of calculation. Before reclamation, the seep area was totally unproductive and the size of the seep was assumed to increase by 10 per cent annually. The recharge area was assumed to be five times as large as the discharge area.[2]

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1. Data obtained from farm survey, Alberta Agriculture, Lethbridge.

2. Soil Salinity Specialists, Alberta Agriculture, Lethbridge.

(iii) Before vegetative reclamation, the producer was on a 50/50, spring wheat/fallow rotation. Both the seep area and the 50 acres of recharge area were seeded to alfalfa with barley as the nurse crop. The rest of the quarter section (100 acres) remained as a spring wheat/fallow rotation.

(iv) Reseeding of alfalfa was assumed necessary in the second year due to poor germination and other problems of establishment.

(v) After six years, it was assumed that both recharge and discharge areas were completely desalinized and were continuously cropped with a spring wheat/barley/rapeseed rotation.

(vi) Alfalfa harvesting was assumed to be done by custom operators.[1]

(vii) Inconvenience costs (machinery operating and repair costs), resulting from farming around the seep were derived by estimating the area of headland created for each farming operation. It was assumed further that two passes were required to cover this area adequately. The additional input costs incurred (seed, fertilizer, chemicals) for which the producer was assumed to receive no returns, were derived by a similar procedure.

(viii) Other assumptions related to yields (except alfalfa),[2] crop prices, costs, fertilizer inputs, method of analysis and reporting results were as outlined in the Introduction.

(ix) Sensitivity analysis was performed on key variables (crop prices, crop yields, discount rates) to determine the stability of the results under varying conditions.

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1. Rates obtained from Guide to Custom Rates, Farm Business Management Branch, Alberta Agriculture and selected C.R.D.'s.

2. Alfalfa yields following reclamation were obtained from Salinity Specialists, Alberta Agriculture, Lethbridge.

11.2.2 Financial Analysis

To determine whether farmers have sufficient incentive and suitably timed cash flows to make the investment in reclamation, the following transfer payments were calculated:

Inflows

(i) Producers who use this soil improvement method are eligible for a land improvement grant. This grant is received annually for five years. Each annual receipt is the lowest of either $700, 7 per cent of the investment or the interest payments of the investment.[1]

(ii) Crop insurance claims were assumed to be twice the amount of the crop insurance payments based on the federal government subsidization of the program.[2]

(iii) It was assumed that for any capital investment the level of equity was zero, that is, the investments required by these projects were financed totally by loans.

(iv) Residual value was assumed to be equal to the sum of all land improvement costs. A value of zero was used as a sensitivity.

(v) Sensitivity analysis was done excluding land improvement grants and crop insurance subsidies.

Outflows

(vi) Crop insurance payments were calculated based on soil zones.

(vii) The interest rate used for loans was 13 per cent, with a repayment period of 10 years.

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1. Loree, Wilson J., Assistance Available for Alberta Farmers, Alberta Agriculture, Agdex 871, 1985.
2. Alberta Hail Crop Insurance Corporation, 16th Annual Report; year ended March 31, 1984.

(viii) Residual capital repayment was determined based on the assumption that the farmer paid off the remainder of the loan at the end of the project period.

(ix) The marginal income tax rate was set at 20 per cent, sensitivity was done at 30 per cent.

11.3 Results

11.3.1 Economic Analysis

The establishment of alfalfa as a control measure, followed by continuous cereal and oilseed cropping, gave a benefit cost ratio of 1.15 with an annual equivalent cash flow of $1.43 per acre (Table 74). Investment costs of alfalfa establishment ($63 per acre), coupled with the foregone earnings from wheat production gave a negative return of approximately $43 per acre in the first two years of alfalfa establishment. The payback period on a discounted cash flow basis was seven to eight years.

TABLE 74

ECONOMIC ANALYSIS OF VEGETATIVE RECLAMATION

	DIC	NPV	AECF	B/C
	($/acre)			(ratio)
Base Scenario[1]	63	11	1.43	1.15

1. 5 per cent discount rate and 10 year average prices and yields.

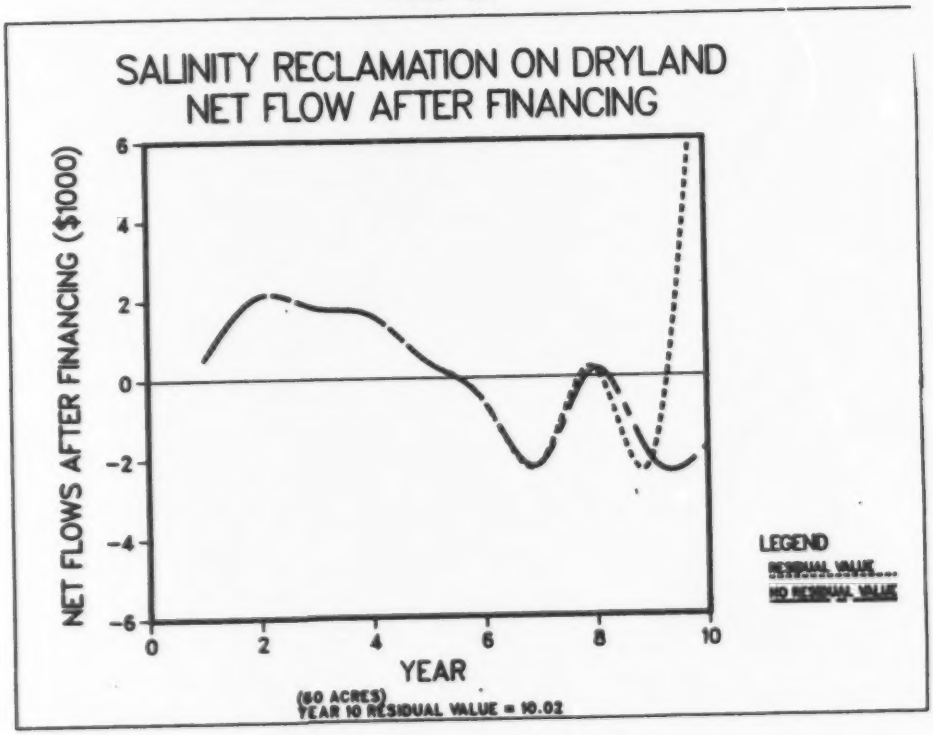
Note: Total losses for first two years = $42.68 per acre.
Payback period = 7 to 8 years.

Results were reduced considerably by 10 per cent decreases in crop prices or yields. A decrease of 20 per cent in crop prices made the project infeasible and 20 per cent decreases in crop yields left the project marginally feasible. Changes in discount rates (3 per cent and 7 per cent) did not affect project feasibility (Appendix X).

11.3.2 Financial Analysis

Examination of the cash flows before and after financing revealed a substantial shift in the distribution of positive and negative flows. Before financing, negative flows occurred in years one and two, in the order of $83 to $17 per acre ($5 000 and $1 000 per 60-acre unit), with highly fluctuating positive flows afterwards. After financing, flows become positive up to year five, then negative in the second half of the project (see Figure 19). The inclusion of a residual value significantly improved the last year in the after financing case, changing it from a negative $33 to a positive $167 per acre. The inclusion of taxes changed the distribution of flows from the after financing case, producing larger positive flows in the first two years and smaller flows thereafter.

FIG. 19



Tables 75 and 76 show that this alternative was financially feasible at all levels of analysis. The exclusion of residual values did not make the alternative impractical, but did make it somewhat marginal, with AECF's after financing in the order of $2.58 per acre, a reduction of more than 80 per cent. The exclusion of subsidies had less of an impact reducing net returns by 50 to 60 per cent (see Table 77). Sensitivity analysis with different discounting and tax rates did not make any cases infeasible (see Appendix X).

TABLE 75

FINANCIAL ANALYSIS: DRYLAND SALINITY[1]
WITH RESIDUAL VALUE FOR BROWN SOIL ZONE

Factor	Total Resources	After Financing	After Fin. & Tax
	($/ac)		
AECF	22.68	18.50	17.49
NPV	175.17	142.86	135.02
	(ratio)		
B/C	1.79	1.29	1.27

TABLE 76

FINANCIAL ANALYSIS: DRYLAND SALINITY[1]
NO RESIDUAL VALUE FOR BROWN SOIL ZONE

Factor	Total Resources	After Financing	After Fin. & Tax
	($/ac)		
AECF	6.77	2.58	3.16
NPV	52.25	19.95	24.40
	(ratio)		
B/C	1.24	1.04	1.05

1. Based on a 5 per cent discount rate and a 10-year project.

TABLE 77

FINANCIAL ANALYSIS: DRYLAND SALINITY[1]
WITH RESIDUAL VALUE FOR BROWN SOIL ZONE
WITHOUT SUBSIDIES

Factor	Total Resources	After Financing	After Fin. & Tax
	($/ac)		
AECF	19.73	7.84	8.96
NPV	152.39	60.56	69.18
	(ratio)		
B/C	1.77	1.13	1.15

11.4 Conclusion

The results of the base scenario indicated very marginal project feasibility. The feasibility of the project as a whole depended on the reclamation rates (and associated yields) and the prices assumed for these products. Slower reclamation rates, which could perhaps reduce yields by 10 per cent, together with a 10 per cent decline in prices would make the project infeasible. Financial results were somewhat more encouraging, with financial AECF's being larger than economic AECF's. Nevertheless, negative flows before and after financing, coupled with the small benefits, do not make this alternative very attractive. The management structure of the farm must be changed to accommodate the vegetative reclamation procedure. This new farm structure (continuous cropping of cereals) demands a high level of management to maintain long-term viability. The results of the study show that this alternative would not be very attractive without current grants and suggests that it may be necessary to provide producers with further financial assistance in the initial years if large-scale vegetative reclamation is to be encouraged.

12. RECLAMATION OF SALINIZED LANDS - IRRIGATED

12.1 Objectives

(i)To provide a general economic analysis of the drainage reclamation of irrigated saline soils.

(ii)To determine whether the drainage reclamation of irrigated saline soils is financially feasible.

12.2 Methodology and Assumptions

12.2.1 Economic Analysis

To determine the on-farm benefits and costs of the reclamation of irrigated saline soils, the following assumptions were made:

(i)The analytic methods, result reporting, and the basic assumptions outlined in the Introduction apply to this study, except where otherwise indicated.

(ii)The analysis was based on the drainage of a 25-acre seep on a 160-acre field, with a project life of 30 years. Drainage installation costs were $13 580 ($549.60 per acre).

(iii)Three irrigation districts (Lethbridge Northern, Bow River, and Eastern) were selected as being representative of irrigated farming conditions in southern Alberta.

(iv)The crop mix used was based on a five-year (1978-1982) average cropping pattern for the five major crops in each of the districts.

(v)Estimated crop yields, in tonnes per acre (and bushels per acre) under low salinity (normal) conditions are given in Table 78.

(vi)Drainage reclamation rates used for three initial levels of salinity, measured in millisiemens/cm (1 mS/cm = 1 millimho/cm) are provided in Table 79.

TABLE 78

ESTIMATED CROP YIELDS UNDER LOW SALINITY CONDITIONS

Crop	Irrigation District BRID	LNID	EID
	tonnes/ac(bus/ac)		
Wheat	1.8 (66.1)	2.0 (73.5)	1.8 (66.1)
Barley	1.9 (87.3)	1.9 (87.3)	1.7 (82.4)
Alfalfa	3.6	3.6	3.6
Silage	18.1 (712.6)	13.6 (535.4)	14.5 (570.8)
Pasture	131 kg/ac	131 kg of beef/ac	131 kg/ac

TABLE 79

RECLAMATION RATES FOR THREE LEVELS OF SALINITY

Salinity Level	Year 1	2	3	4	5	6	7	8
				mS/cm				
High	11.4	8.9	7.1	5.5	4.4	3.4	2.7	2.1
High-medium	9.7	7.6	6.0	4.7	3.7	2.9	2.3	1.8
Medium	8.0	6.3	4.9	3.9	3.1	2.4	1.9	1.5

(vii)Crop yields are affected in direct proportion to the level of salinity, especially in the top 30 cm of soil. Because this zone is the first to be leached of salts, increases in yield were assumed earlier than might otherwise have been expected.

(viii) During the first year of the project no cropping was done on the drained seep. Cropping was not done in subsequent years if a loss had been predicted for farming the seep (using assumed yields, prices and cost). Notwithstanding this limitation, yields rose in accordance with decreasing salinity and were assumed to remain at 100 per cent of normal yields from the time the salinity level fell below 2.7 mS/cm.

(ix) Benefits included both increased crop production and increased efficiency in farming on the entire 160 acres.

12.2.2 Financial Analysis

To convert the economic analysis to financial analysis the following transfer payments were evaluated:

Inflows

(i) Farmers installing drainage are eligible for an Alberta Farm Development Loan (AFDL) and a loan incentive under the Range and Soil Improvement Program. The loan for drainage installation was shown as an inflow in year one, and for the first five years a rebate of $700 per year was assumed.

(ii) Crop insurance claims were assumed to be twice the value of payments.

(iii) In year 30, a residual land value equal to the cost of the improvement was shown as an inflow. Sensitivity analysis was done with a zero residual value.

(iv) Sensitivity analysis was done excluding land improvement grants and crop insurance subsidies.

Outflows

(v) Incremental operating capital was calculated as 85 per cent of the change in production expenditure of the following year.

(vi)The loan for drainage was amortized over 10 years with an interest rate of 13 per cent.

(vii)Crop insurance payments were based on cost of production data and charged at $5.64 per acre from the first year of production on drained land.

(viii)Land, income and capital gains taxes were quantified. Land tax prior to drainage was negligible on the seep area; the land tax was charged from the second year of the project. A marginal tax rate of 20 per cent was assumed, with sensitivity at 30 per cent. Capital gains tax was on one-half the residual value of land.

12.3 Results

12.3.1 Economic Analysis

Results given in Table 80 showed that drainage reclamation of irrigated saline land is economically feasible, given the earlier assumptions. There were slight differences between the districts and salinity levels considered. In general, the net returns were higher in BRID than in the other two districts, and slightly higher with medium levels of salinity than high levels.

Discounted investment costs of $84 000 to $88 000 represent mainly the costs of production on the 25-acre drainage area. Actual discounted drainage investment costs were $523.40 per acre. The total net present values (NPV's) of the project ranged from $13 000 to $22 000. This converted to $612 to $877 per acre on a 25-acre basis. The AECF's ranged from $35 to $57 per acre. Benefit cost ratios ranged from 1.16 to 1.26, and IRR's from 11 to 15 per cent.

Sensitivity analyses were performed to measure the effects of higher or lower gross revenue, resulting from changes in prices or yields, higher costs, and different discount rates. The impact of a longer reclamation period (8 years) was not examined but would be similar to that of a 10 per cent decrease in gross revenue.

TABLE 80

ECONOMIC PERFORMANCE MEASURES FOR THE DRAINAGE OF IRRIGATED SALINE LAND[1]

District	Level	Discounted Revenue ($)	Discounted Costs ($)	NPV	DIC	AECF	B/C	IRR
				------($/ac)-----			(ratio)	(%)
BRID	High	104 169	85 305	755	523	49	1.22	13
	Medium	107 602	85 688	877	523	57	1.26	15
LNID	High	101 199	85 903	612	523	40	1.18	12
	Medium	105 544	87 742	712	523	46	1.20	14
EID	High	97 162	83 859	531	523	35	1.16	11
	Medium	101 353	85 575	631	523	41	1.18	13

1. Discount rate of 5 per cent.

A 10 per cent change in gross revenue caused the B/C ratio to change by approximately 0.12 in the same direction. The NPV's changed by about $384 to $429 per acre for each 10 per cent change in gross revenue. The project would still be feasible with a 10 per cent decrease in gross revenue; however, a 20 per cent drop in gross revenue resulted in B/C ratios of below 1.0 and negative NPV's, making drainage economically infeasible.

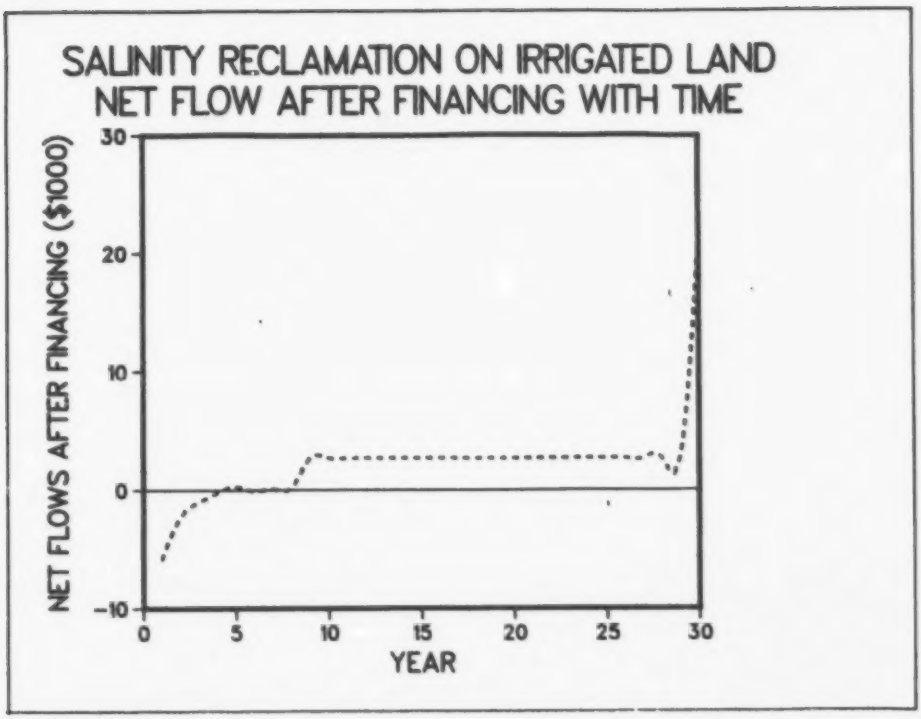
A 10 per cent increase in drainage installation cost had the same effect in all three irrigation districts, namely, raising total discounted costs by $1 309. The NPV's dropped by $50 to $55 per acre and the B/C ratios dropped by 0.02. Because drainage costs were minor compared to crop revenues and production costs, the project was not particularly sensitive to this cost item.

A decrease in the discount rate to 3 per cent had the effect of increasing the B/C ratio by approximately 0.05, and increasing the NPV's by 59 per cent, 52 per cent, and 61 per cent in the LNID, BRID, and EID, respectively. When an increase in the discount rate to 7 per cent lowered the B/C ratio by about 0.05, and decreased the NPV's by 40 per cent, 37 per cent, and 42 per cent, all projects remained feasible. A combination of adverse conditions (10 per cent increase in drainage and production costs and 10 per cent decreases in both yields and prices) would make drainage infeasible. Extending the project life to 50 years, to include a residual value, had the effect of increasing the B/C ratios by about 0.08 and the AECF's by about $18 to $20 per acre. A further extension to 95 years increased the B/C ratios by another 0.04 points. The results of sensitivity analysis are summarized in Appendix XI.

12.3.2 Financial Analysis

Three levels of cash flow analysis were undertaken for the project. The first examined the inflows and outflows, and the net benefit before financing stream. The second examined the situation after financing and the third after financing and taxes. Before financing and taxes there were negative flows (undiscounted) of $680 to $720 per acre ($17 000 to $18 000 per 25-acre unit) in the first one to three years of the project. These reflected mainly the drainage installation costs. After financing, negative flows continued into year six for BRID and year ten for the other two districts, reflecting loan repayments (see Figure 20). These were somewhat smaller in value, being approximately $7 000 to $12 000 per 25-acre unit (undiscounted). After allowance for tax deductions and income tax payments, negative flows were still shown for ten years in each irrigation district. The total undiscounted values of these negative flows fell to between $4 000 and $10 000 per 25-acre unit, however, reflecting the tax savings on the rest of the farm.

FIG. 20



All cases examined were financially feasible, with AECF's to total resources ranging from $44 to $60 per acre and B/C ratios of 1.2 to 1.3. The IRR's were between 10 and 13 per cent (see Table 81). Results were best in the BRID; values were lower for LNID and EID, in that order.

Values for medium salinity were better than for high salinity in all cases. The AECF's to the farmer's resources, after financing, were somewhat lower than those before financing. Nevertheless, B/C ratios and IRR's were not substantially different, indicating the ability of the projects to withstand the loan conditions. After taxes, AECF's and B/C ratios fell further, but IRR's recovered or improved. Exclusion of a residual value made some cases less profitable (see Table 82). Removal of subsidies reduced net returns by 25 to 30 per cent (see Table 83). The sensitivity analysis indicated that all cases, except EID with a high salinity level, withstood discount rates of up to 10 per cent, but were fairly marginal at that rate. A marginal tax rate of 30 per cent had little impact on the feasibility of drainage (see Appendix XI).

TABLE 81

FINANCIAL ANALYSIS[1]: RECLAMATION OF SALINIZED LAND - IRRIGATED WITH RESIDUAL VALUE

Irrigation District	Level of Salinity	Total Resources	AECF After Financing	After Fin. & Tax
		($/ac)		
BRID	High	52.64	43.90	37.47
	Medium	60.34	51.60	39.64
LNID	High	42.96	34.21	29.72
	Medium	49.09	40.34	34.62
EID	High	37.92	29.18	25.69
	Medium	44.06	35.32	30.61
		Total Resources	NPV After Financing	After Fin. & Tax
		($/ac)		
BRID	High	809	675	576
	Medium	928	793	609
LNID	High	660	526	457
	Medium	755	620	532
EID	High	583	449	395
	Medium	677	543	470
		Total Resources	B/C After Financing	After Fin. & Tax
		(ratio)		
BRID	High	1.22	1.15	1.13
	Medium	1.25	1.18	1.15
LNID	High	1.18	1.12	1.10
	Medium	1.20	1.14	1.12
EID	High	1.16	1.10	1.09
	Medium	1.19	1.12	1.10

1. At a 5 per cent discount rate and based on 25 acres.

TABLE 82

FINANCIAL ANALYSIS[1]: RECLAMATION OF SALINIZED LAND - IRRIGATED
NO RESIDUAL VALUE

Irrigation District	Level of Salinity	Total Resources	AECF After Financing	After Fin. & Tax
		($/ac)		
BRID	High	44	36	30
	Medium	52	43	36
LNID	High	35	26	22
	Medium	41	32	27
EID	High	30	21	18
	Medium	36	27	23

		Total Resources	NPV After Financing	After Fin. & Tax
		($/ac)		
BRID	High	684	549	463
	Medium	802	667	558
LNID	High	535	400	343
	Medium	629	494	419
EID	High	457	323	282
	Medium	552	417	357

		Total Resources	B/C After Financing	After Fin. & Tax
		(ratio)		
BRID	High	1.19	1.12	1.10
	Medium	1.22	1.15	1.12
LNID	High	1.15	1.09	1.08
	Medium	1.17	1.11	1.09
EID	High	1.13	1.07	1.06
	Medium	1.15	1.09	1.08

1. At a 5 per cent discount rate and based on 25 acres.

TABLE 83

FINANCIAL ANALYSIS[1]: RECLAMATION OF SALINIZED LAND - IRRIGATED WITH RESIDUAL VALUE WITHOUT SUBSIDIES

Irrigation District	Level of Salinity	Total Resources	AECF After Financing	After Fin. & Tax
		($/ac)		
BRID	High	47.35	30.72	26.93
	Medium	55.05	38.42	33.08
LNID	High	38.04	21.41	19.48
	Medium	44.17	27.54	24.38
EID	High	32.93	16.30	15.39
	Medium	39.07	22.44	20.30
		Total Resources	NPV After Financing	After Fin. & Tax
		($/ac)		
BRID	High	728	472	414
	Medium	846	591	509
LNID	High	585	329	299
	Medium	679	423	375
EID	High	506	251	267
	Medium	601	345	312
		Total Resources	B/C After Financing	After Fin. & Tax
		(ratio)		
BRID	High	1.20	1.11	1.09
	Medium	1.24	1.14	1.11
LNID	High	1.16	1.08	1.07
	Medium	1.19	1.10	1.08
EID	High	1.14	1.06	1.06
	Medium	1.17	1.08	1.07

1. At a 5 per cent discount rate and based on 25 acres.

12.4 Conclusion

Drainage of irrigated saline soils was shown to be economically and financially feasible under the assumptions in this analysis. Economic B/C ratios were fairly marginal but IRR's were above 10 per cent. Here, the implication is that at real discount rates above 11 to 13 per cent it is not economically feasible to drain soils of high salinity, and at real discount rates of 13 to 15 per cent it is not economically feasible to drain soils of medium salinity. Below these real discount rates drainage is economically feasible. For purposes of comparing this alternative with others, the highest B/C ratio and AECF were chosen. These corresponded with medium salinity levels in BRID. There was little variation between districts and salinity levels.

Existing subsidies have a fairly large impact on net returns, their removal would reduce returns by 25 to 30 per cent. Although financially feasible, there were large negative flows in the first 2 to 10 years of the project, both before and after financing. These negative flows would be a disincentive to farmers to make such an investment. A net deficit of $4 000 to $10 000 in the first 10 years of the project must be made up from a farmer's savings, income from the rest of the farm or other sources. Other alternatives would be additional incentives in the form of short-term credit; alterations to the longer-term credit; or a grant or subsidy for drainage to offset the cash deficit in the first one to three years of the project. The latter incentive would be justified not only by the economic feasibility of the investment but also by the long-term implications of a failure to arrest salinization of agricultural lands.

13. EVALUATION OF ALTERNATIVES BY DIRECT BENEFIT AND COST CRITERIA

Marginal economic and financial analyses were undertaken to determine whether a number of proposed alternatives for agricultural resource development would be beneficial from the standpoint of the economy as a whole and from that of the farmer. Results were used to compare these alternatives on the basis of their economic potential and financial attractiveness. The results of the discount analysis, for the ten alternatives evaluated by Alberta Agriculture, are summarized in Tables 84 (economic) and 85 (financial). These represent the complete set of results for all sub-options and show the range of profitability by soil zones or other sub-options, within each management alternative.[1]

In most cases the financial returns to the farmer were slightly below the economic returns to the economy as a whole. This difference reflects mainly interest payments on capital investment loans for which zero equity was assumed. In a few cases, the financial returns were greater than the economic, reflecting larger transfer payments from the economy to the producer than vice versa, and in particular reflecting low interest payments for small investments.

The discounted investment cost per acre varied considerably between alternatives. Most management alternatives directed at improving existing situations through ameliorating specific soil problems had investment costs below $100 per acre. These included liming acid soils, deep plowing solonetzic soils and reclaiming dryland saline soils. Alternatives directed at intensifying production through changes such as range conversion, reseeding native prairie and summerfallow reduction also had low investment costs. Where more major changes involved large capital expenditure, the discounted investment costs rose to between $200

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1. Economic base case results do not include a residual land value, whereas financial base case results include a residual land value. Summary financial results reported here are for after financing but before taxes (since farmers' marginal tax rates vary greatly). For more details and sensitivity analysis see the individual sections for each alternative.

TABLE 84

ECONOMIC ANALYSIS: SUMMARY OF RESULTS BY ALTERNATIVES[1]

Alternative	DIC[2]	NPV[3]	AECF[4]	B/C[5]
	--------($/acre)-------			(ratio)
Green Area Conversion	338-429	123-242	8-16	1.12-1.26
Irrigation Expansion	367-476	625-2739	41-178	1.62-2.35
Drainage	372-589	250-904	16-59	1.23-1.70
Deep Plowing Solonetzic Soils	93	90-315	12-41	1.97-4.37
Liming Acid Soils	54	37-50	5-7	1.68-1.94
Summerfallow Reduction	6-31	-55-80	-8-11	0.43-1.60
Range Improvement	65-279	-108-298	-9-24	0.95-1.25
Range Conversion	52-173	226-333	29-43	1.82-2.06
Woodland Conversion	214	307-710	22-50	1.39-1.68
Reclamation of Saline Soils				
Dryland (Vegetative)	63	11	1	1.15
Irrigated (Drainage)	523	531-877	35-57	1.16-1.26

1. Base case results with no residual land value.
2. DIC - discounted investment cost (initial cost of project).
3. NPV - net present value of returns.
4. AECF - annual equivalent cash flow.
5. B/C - benefit/cost ratio.

TABLE 85

FINANCIAL ANALYSIS: SUMMARY OF RESULTS BY ALTERNATIVES[1]

Alternative	NPV[2] ----($/acre)----	AECF[3]	B/C[4] (ratio)
Green Area Conversion	-404- -269	-26- -18	0.86-0.89
Irrigation Expansion	440-2473	33-161	1.25-1.81
Drainage	265-804	17-52	1.20-1.50
Deep Plowing Solonetzic Soils	133-357	17-46	1.57-2.53
Liming Acid Soils	73-86	10-11	1.55-1.65
Summerfallow Reduction	-50-90	-7-13	0.48-1.62
Range Improvement	-152-258	-12-21	0.97-1.11
Range Conversion	220-299	28-41	1.44-1.57
Woodland Conversion	364-798	47-103	1.31-1.56
Reclamation of Saline Soils			
Dryland (Vegetative)	143	19	1.29
Irrigated (Drainage)	449-793	29-51	1.10-1.18

1. Results after financing but before taxes (with a residual land value).
2. NPV - net present value of returns.
3. AECF - annual equivalent cash flow.
4. B/C - benefit/cost ratio.

and $600 per acre. These included expansion into the Green Area, irrigation expansion, drainage, woodland range improvement, converting woodland to cropland (on existing farms) and draining irrigated saline soils.

Most low investment cost alternatives had low to moderate returns, (economic NPV's of -$15 to $333 and AECF's of -$2 to $43 per acre). High investment cost alternatives had NPV's which ranged between -$108 and $2 739 per acre and AECF's between -$9 and $178 per acre. Details of comparisons within alternatives by soil zones and irrigation climatic zones are provided in Tables 86 (economic) and 87 (financial). These tables present only the most reasonable or most beneficial sub-option for each zone. For further analysis and comparison, alternatives were separated into high investment costs (above $200 per acre) and low investment costs (below $200 per acre), and secondly by soil zone.

13.1 High Investment Cost Alternatives

The high investment cost alternatives are compared by economic and financial AECF's in Tables 88 and 89. Irrigation intensification and expansion had higher returns relative to other high investment cost (over $200 per acre) alternatives. For equivalent investments in irrigation there was a wide variation in returns, with Zone A1 having the highest return per acre and per dollar invested and Zone C the lowest. Woodland range improvement had the lowest economic AECF, followed by Green Area conversion. Evaluation by financial analysis improved the position of woodland conversion on Black (to fourth) while that on Gray retained a low position. Green Area conversion moved from tenth to last place.

13.2 Low Investment Cost Alternatives

Lower investment cost (under $200 per acre) alternatives were also compared by economic and financial AECF's (Tables 90 and 91). Range conversion on Dark Brown and Black and deep plowing solonetzic on Black had the highest economic AECF, while summerfallow reduction and prairie

TABLE 86

SUMMARY OF ECONOMIC RESULTS BY SUB-OPTIONS

Alternative	Zone	Sub-Option	DIC	NPV ($/ac)	AECF	B/C (ratio)
Green Area Conversion	Gray[1]	960 ac. (1/4-3/4)	338	223	15	1.26
Irrigation Expansion	A1	Expansion	367	1 998	130	2.33
	A2			1 344	87	2.01
	B			1 089	71	1.90
	C			625	41	1.62
	A1	Int./Ext.	476	2 739	178	2.35
	A2			1 850	120	2.03
	B			1 503	98	1.93
	C			872	57	1.64
Drainage	Peace		373	482	31	1.51
	Athabasca		453	338	22	1.32
	Beaver		502	250	16	1.23
	North Saskatchewan		554	770	50	1.63
	Battle		589	904	59	1.70
Deep Plowing Solonetzic Soils	Black[2]		93	315	41	4.37
	Dark Brown		93	105	14	2.13
	Brown		93	90	12	1.97
Liming Acid Soils	Gray[1]		54	37	5	1.68
	Dark Brown		54	49	6	1.92
	Black[2]		54	50	7	1.94
Summerfallow Reduction	Brown	1/2-1/2 vs 1/3-2/3	12	-15	-2	0.80
	Dark Brown	1/3-2/3 vs C/C	31	65	9	1.31
	Black[2]	1/4-3/4 vs C/C	16	32	5	1.25
	Black[3]	1/4-3/4 vs C/C	16	76	11	1.60
	Gray[1]	1/4-3/4 vs C/C	15	23	3	1.20

TABLE 86 (continued)

SUMMARY OF ECONOMIC RESULTS BY SUB-OPTIONS

Alternative	Zone	Sub-Option	DIC	NPV ($/ac)	AECF	B/C (ratio)
Range Improvement	Brown	Prairie Range	65	4	0	1.01
	Dark Brown	Prairie Range	65	189	15	1.22
	Black	Prairie Range	65	298	24	1.25
	Black	Woodland Range	279	-108	- 9	0.95
	Gray[1]	Woodland Range	279	- 86	- 7	0.96
Range Conversion	Brown	Reduced Herd	52	226	29	2.04
	Dark Brown	Reduced Herd	173	333	43	2.06
	Black	Reduced Herd	78	310	40	1.82
	Gray[1]	Reduced Herd	88	260	34	1.95
Woodland Conversion	Black	80 acres	214	710	50	1.68
	Gray[1]	160 acres	214	307	22	1.39
Reclamation of Saline Lands Dryland Irrigated	Brown	Vegetative	63	11	1	1.15
	BRID	Drainage	523	877	57	1.26

1. Peace River area.

2. Northeast.

3. Central.

TABLE 87

SUMMARY OF FINANCIAL RESULTS BY SUB-OPTIONS[1]

Alternative	Zone	Sub-Option	NPV	AECF	B/C
			----($/ac)---		(ratio)
Green Area Conversion	Gray[2]	960 ac.	-269	-18	0.89
Irrigation Expansion	A1	Expansion	1 867	121	1.81
	A2		1 193	78	1.57
	B		918	60	1.48
	C		501	33	1.30
	A1	Int./Ext.	2 474	161	1.80
	A2		1 580	103	1.56
	B		1 224	80	1.47
	C		656	43	1.29
Drainage	Peace		482	31	1.50
	Athabasca		349	23	1.30
	Beaver		265	17	1.20
	North Saskatchewan		697	45	1.40
	Battle		804	52	1.40
Deep Plowing Solonetzic Soils	Black[3]		357	46	2.53
	Dark Brown		147	19	1.63
	Brown		133	17	1.57
Liming Acid Soils	Gray[2]		73	10	1.55
	Dark Brown		83	11	1.62
	Black[3]		86	11	1.65
Summerfallow Reduction[5]	Brown	1/2-1/2 vs 1/3-2/3	-12	-2	0.86
	Dark Brown	1/3-2/3 vs C/C	73	10	1.32
	Black[3]	1/4-3/4 vs C/C	39	5	1.29
	Black[4]	1/4-3/4 vs C/C	83	12	1.62
	Gray[2]	1/4-3/4 vs C/C	30	4	1.25

TABLE 87 (continued)

SUMMARY OF FINANCIAL RESULTS BY SUB-OPTIONS[1]

Alternative	Zone	Sub-Option	NPV ($/ac)	AECF ($/ac)	B/C (ratio)
Range Improvement	Brown	Prairie Range	7	-5	1.01
	Dark Brown	Prairie Range	165	13	1.10
	Black	Prairie Range	258	21	1.10
	Black	Woodland Range	-152	-12	0.97
	Gray	Woodland Range	-133	-11	0.97
Range Conversion	Brown	Reduced Herd	220	28	1.48
	Dark Brown	Reduced Herd	319	41	1.56
	Black	Reduced Herd	299	39	1.44
	Gray	Reduced Herd	277	36	1.57
Woodland Conversion	Black	80 acres	798	103	1.56
	Gray	160 acres	364	47	1.31
Reclamation of Saline Lands Dryland	Brown	Vegetative	143	19	1.29
Irrigated	BRID	Drainage	793	52	1.18

1. After financing but before taxes (with a residual land value).

2. Peace River area.

3. Northeast.

4. Central.

5. No residual land value.

TABLE 88

HIGH INVESTMENT COST ALTERNATIVES
BY ECONOMIC AECF AND B/C RATIO

	AECF ($/ac)	B/C (ratio)	DIC ($/ac)	Alternatives	
1	178	2.35	476	Irrigation Int./Ext.	Zone A1
2	130	2.33	367	Irrigation Expansion	Zone A1
3	120	2.03	476	Irrigation Int./Ext.	Zone A2
4	98	1.93	476	Irrigation Int./Ext.	Zone B
5	87	2.01	367	Irrigation Expansion	Zone A2
6	71	1.90	367	Irrigation Expansion	Zone B
7	61	1.79	520	Drainage	N. Sask.
8	59	1.70	589	Drainage	Battle
9	57	1.64	367	Irrigation Int./Ext.	Zone C
10	57	1.26	523	Irrigated Saline Drainage	BRID
11	50	1.68	214	Woodland Conversion	Black
12	41	1.62	367	Irrigation Expansion	Zone C
13	31	1.51	372	Drainage	Peace
14	22	1.39	214	Woodland Conversion	Gray
15	22	1.32	453	Drainage	Athabasca
16	16	1.23	502	Drainage	Beaver
17	15	1.26	338	Green Area Conversion	960 Acres
18	-7	0.96	279	Woodland Range Improvement	Gray
19	-9	0.95	279	Woodland Range Improvement	Black

TABLE 89

HIGH INVESTMENT COST ALTERNATIVES
BY FINANCIAL AECF AND B/C RATIO

	AECF ($/ac)	B/C (ratio)	Alternatives	
1	161	1.80	Irrigation Int./Ext.	Zone A1
2	121	1.81	Irrigation Expansion	Zone A1
3	103	1.56	Irrigation Int./Ext.	Zone A2
4	103	1.56	Woodland Conversion	Black
5	78	1.57	Irrigation Expansion	Zone A2
6	80	1.47	Irrigation Int./Ext.	Zone B
7	60	1.48	Irrigation Expansion	Zone B
8	52	1.40	Drainage	Battle
9	52	1.18	Irrigated Saline Drainage	BRID
10	47	1.45	Irrigation Expansion	Zone C
11	47	1.31	Woodland Conversion	Gray
12	45	1.40	Drainage	N. Sask.
13	43	1.29	Irrigation Int./Ext.	Zone C
14	31	1.50	Drainage	Peace
15	23	1.30	Drainage	Athabasca
16	17	1.20	Drainage	Beaver
17	-11	0.97	Woodland Range Improvement	Gray
18	-12	0.97	Woodland Range Improvement	Black
19	-18	0.89	Green Area Conversion	Gray

TABLE 90

LOW INVESTMENT COST ALTERNATIVES
BY ECONOMIC AECF AND B/C RATIO

	AECF ($/ac)	B/C (ratio)	DIC ($/ac)	Alternatives	
1	43	2.06	88	Range Conversion	Dark Brown
2	41	4.37	93	Deep Plowing Solonetzic Soils	Black
3	40	1.82	78	Range Conversion	Black
4	34	1.95	173	Range Conversion	Gray
5	29	2.04	52	Range Conversion	Brown
6	24	1.25	65	Prairie Range Improvement	Black
7	15	1.22	65	Prairie Range Improvement	Dark Brown
8	14	2.13	93	Deep Plowing Solonetzic Soils	Dark Brown
9	12	1.97	93	Deep Plowing Solonetzic Soils	Brown
10	11	1.60	16	Summerfallow Reduction (1/4-3/4 vs C/C)	Black (Central)
11	9	1.31	31	Summerfallow Reduction (1/3-2/3 vs C/C)	Dark Brown
12	7	1.94	54	Liming Acid Soils	Black
13	6	1.92	54	Liming Acid Soils	Dark Brown
14	5	1.68	54	Liming Acid Soils	Gray
15	5	1.25	16	Summerfallow Reduction (1/4-3/4 vs C/C)	Black (N.E.)
16	3	1.20	15	Summerfallow Reduction (1/4-3/4 vs C/C)	Gray
17	1	1.15	63	Dryland Saline Reclamation	Brown
18	1	1.01	65	Prairie Range Improvement	Brown
19	-2	0.80	12	Summerfallow Reduction (1/4-3/4 vs C/C)	Brown

TABLE 91

LOW INVESTMENT COST ALTERNATIVES
BY FINANCIAL AECF AND B/C RATIO

	AECF ($/ac)	B/C (ratio)	Alternatives	
1	46	2.53	Deep Plowing Solonetzic Soils	Black
2	41	1.56	Range Conversion	Dark Brown
3	39	1.44	Range Converson	Black
4	36	1.57	Range Conversion	Gray
5	28	1.48	Range Conversion	Brown
6	21	1.27	Prairie Range Improvement	Black
7	19	1.63	Deep Plowing Solonetzic Soils	Dark Brown
8	19	1.29	Dryland Saline Reclamation	Brown
9	17	1.57	Deep Plowing Solonetzic Soils	Brown
10	13	1.25	Prairie Range Improvement	Dark Brown
11	12	1.62	Summerfallow Reduction	Black (Central)
12	11	1.65	Liming Acid Soils	Black (N.E.)
13	11	1.62	Liming Acid Soils	Dark Brown
14	10	1.55	Liming Acid Soils	Gray
15	10	1.32	Summerfallow Reduction	Dark Brown
16	5	1.29	Summerfallow Reduction	Black (N.E.)
17	4	1.25	Summerfallow Reduction	Gray
18	1	1.10	Prairie Range Improvement	Brown
19	-2	0.86	Summerfallow Reduction	Brown

rangeland improvement on Brown were lowest. With financial analysis, deep plowing solonetzic on Black moved to first place, and the positions of range conversion remained basically the same as in the economic analysis. Dryland saline reclamation moved up from seventeenth to eighth position. The changes in relative position with moving from economic to financial analysis reflect variations in subsidies, grants and other transfer payments between the alternatives.

13.3 Alternatives by Soil Zone

The alternatives examined are compared by economic AECF by soil zone in Table 92. Financial AECF's are provided for comparisons. In the Brown soil zone, irrigation intensification and expansion in Zone A1 had the highest values. Both had high investment costs. Reclaiming dryland saline soils and summerfallow reduction had the lowest values.

Irrigation intensification and expansion in Zone B had the highest values in the Dark Brown soils, followed by drainage in the Battle. Summerfallow reduction and liming acid soils were last. In the Black soil zone, woodland conversion and drainage were the highest, followed by deep plowing solonetzic soils. Summerfallow reduction (Northeast) and woodland range improvement gave the lowest returns. Finally, on the Gray, range conversion and drainage had the highest values. Woodland range improvement had the lowest.

13.4 Overall Evaluation

Overall evaluation of alternatives is difficult because of the wide range of results within alternatives. For this reason sub-options or groups of sub-options with similar returns were used to compare the ten management alternatives considered in this study. The results appear in Table 93. Irrigation in Zones A1, A2 and B had the highest economic AECF's ranging between $71 and $178 per acre but one of the highest investment costs. The alternatives in second and third positions (drainage in the Battle and reclamation of saline soils) had economic

TABLE 92

ECONOMIC AECF BY SOIL ZONE[1]

	Alternative	Economic AECF ---($/ac)----	Fin. AECF	Econ. B/C (ratio)	Level of Investment
Brown					
1	Irrigation Intensification (A1)	178	161	1.8	High
2	Irrigation Expansion (A1)	130	121	1.8	High
3	Irrigation Intensification (A2)	120	103	1.6	High
4	Irrigation Expansion (A2)	87	78	1.6	High
5	Reclamation of Saline Soils (irrigated)	57	52	1.3	High
6	Range Conversion	29	28	2.0	Low
7	Deep Plowing Solonetzic Soils	12	17	2.0	Low
8	Range Improvement (prairie)	.3	1	1.0	Low
9	Reclamation of Saline Soils (dryland)	1	19	1.2	Low
10	Summerfallow Reduction (1/2-1/2 to 1/3-2/3)	-2	-2	0.8	Low
Dark Brown					
1	Irrigation Intensification (B)	98	80	1.5	High
2	Irrigation Expansion (B)	71	60	1.5	High
3	Drainage (Battle)	59	52	1.7	High
4	Irrigation Int./Ext. (C)	57	43	1.3	High
5	Range Conversion	43	41	2.1	Low
6	Irrigation Expansion (C)	41	33	1.3	High
7	Range Improvement (prairie)	15	13	1.2	Low
8	Deep Plowing Solonetzic Soils	14	19	2.1	Low
9	Summerfallow Reduction (1/3-2/3 to C/C)	9	10	1.3	Low
10	Liming Acid Soils	6	11	1.9	Low

TABLE 92 (continued)

ECONOMIC AECF BY SOIL ZONE[1]

	Alternative	Economic AECF ---($/ac)----	Fin. AECF	Econ. B/C (ratio)	Level of Investment
Black					
1	Woodland Conversion (80 acres)	50	103	1.7	High
2	Drainage (North Saskatchewan)	50	56	1.6	High
3	Deep Plowing Solonetzic Soils	41	46	4.4	Low
4	Range Conversion	40	39	1.8	Low
5	Range Improvement (prairie)	24	21	1.3	Low
6	Summerfallow Reduction (1/4-3/4 to C/C) Central	11	12	1.6	Low
7	Liming Acid Soils	7	11	1.9	Low
8	Summerfallow Reduction (1/4-3/4 to C/C) Northeast	5	5	1.3	Low
9	Range Improvement (woodland)	-9	-12	1.0	High
Gray					
1	Range Conversion	34	36	1.9	Low
2	Drainage (Peace)	31	35	1.5	High
3	Woodland Conversion (160 acres crops)	22	47	1.4	High
4	Drainage (Athabasca)	22	28	1.3	High
5	Drainage (Beaver)	16	24	1.2	High
6	Green Area Conversion (960 acres 1/4-3/4)	15	-18	1.3	High
7	Liming Acid Soils	5	10	1.7	Low
8	Summerfallow Reduction (1/4-3/4 to C/C)	3	4	1.2	Low
9	Range Improvement (woodland)	-7	-11	1.0	High

1. Financial AECF provided for comparison.

TABLE 93

OVERALL EVALUATION OF MAJOR ALTERNATIVES BY AECF
(DIRECT BENEFITS AND COSTS)[1]

Economic	Financial	Alternative	Economic AECF[2]	Financial AECF[3]	Level of Investment
			------($/acre)-----		
1	1	Irrigation Exp/Int (Zones A1, A2 and B)	71-178	60-161	High
2	3	Drainage (Battle)	59	52	High
3	4	Reclamation of Saline Soils (Irrigated)	57	52	High
4	5	Irrigation Exp/Int (Zone C)	41-57	33-43	High
5	2	Woodland Conversion (Black)	50	103	High
6	8	Drainage (N.Sask.)	50	45	High
7	9	Range Conversion (Dark Brown)	43	41	Low
8	7	Deep Plowing Solonetzic Soils (Black)	41	46	Low
9	10	Range Conversion (Black)	40	39	Low
10	11	Range Conversion (Gray)	34	36	Low
11	12	Drainage (Peace)	31	31	High
12	13	Range Conversion (Brown)	29	28	Low
13	15	Prairie Range Improvement (Black)	24	21	Low
14	14	Drainage (Athabasca)	22	23	High
15	6	Woodland Conversion (Gray)	22	47	High
16	18	Drainage (Beaver)	16	17	High
17	19	Prairie Range Improvement (Dark Brown)	15	13	Low

TABLE 93 (continued)

OVERALL EVALUATION OF MAJOR ALTERNATIVES BY AECF
(DIRECT BENEFITS AND COSTS)[1]

Economic	Financial	Alternative	Economic AECF[2] ($/acre)	Financial AECF[3] ($/acre)	Level of Investment
18	26	Green Area Conversion	15	-18	High
19	17	Deep Plowing Solonetzic Soils (Dark Brown and Brown)	12-14	17-19	Low
20	20	Summerfallow Reduction (Black Central and Dark Brown)	9-11	10-12	Low
21	21	Liming Acid Soils (all sub-options)	5-7	10-11	Low
22	22	Summerfallow Reduction (Gray and Black Northeast)	3-5	4-5	Low
23	16	Reclamation of Saline Lands (Dryland)	1	19	Low
24	23	Prairie Range Improvement (Brown)	1	1	Low
25	24	Summerfallow Reduction (Brown)	-2	-2	Low
26	25	Woodland Range Improvement (Black and Gray)	-9--7	-12--11	High

1. Infrastructure costs and opportunity costs of non-agricultural uses not included.

2. With no residual land value.

3. After financing but before taxes, with zero equity in the investment and a residual land value included.

AECF's of $59 and $57 per acre respectively and were again high-cost investments. Next was irrigation in Zone C at $41-57 per acre.

A number of alternatives had AECF's of between $40 and $50 per acre. These included range conversion on Dark Brown and Black soils and drainage in the North Saskatchewan. Another group fell into the category having AECF's of $20 to $30 per acre, these included woodland conversion on Gray and prairie range improvement on Black. After this AECF's were below $20 per acre and negative in a couple of cases.

The evaluation was changed by the financial analysis. Irrigation (Zones A1, A2 and B) retained the first position, but woodland conversion (Black) replaced drainage (Battle) in second position. Woodland conversion on Gray moved from fifteenth to sixth place, and reclamation of dryland saline soils from twenty-third to sixteenth. Green Area Conversion fell to the twenty-sixth position. All other alternatives retained basically the same positions.

13.5 Conclusion

A number of options or alternatives for increased agricultural production were examined in this study. While these are not necessarily exclusive their comparison on a common basis is useful for purposes of making investment decisions. This comparison was achieved through discount analysis. Discounting the stream of costs and benefits of an investment reduces them to their present worth or value. This is done to determine whether the investment will yield a return greater than alternative uses of money invested. In this study a real discount rate of 5 per cent (nominal rate adjusted for inflation) was assumed as the alternative use of money. Where the net value of the discounted streams (NPV) is positive or the ratio of discounted benefits to discounted costs (B/C) is one or greater, the project is viable.

Using these criteria, all alternatives (with the exception of summerfallow reduction on Brown soils and woodland range improvement) were shown to be economically viable. Green Area Conversion was econo-

mically viable but not financially viable (at a zero equity level). All other alternatives (except summerfallow reduction on Brown and woodland range improvement) were financially viable. The viable or acceptable alternatives cannot be ranked by NPV or B/C ratio, since the NPV is an absolute and not a relative measure and ranking by B/C ratio can lead to erroneous investment choices.

For improved comparisons of the various alternatives, the NPV's were converted to annual equivalent cash flows (AECF's). This involves the implicit assumption of a continuous replacement cycle. Comparison by economic AECF's indicates from the economy's viewpoint which investment would give the best returns per acre improved. The financial AECF's provide an insight into whether the farmer would have the correct or sufficient incentives to make the investment. The investment costs and opportunity costs must also be considered when comparing alternatives.

None of the measures used in this study indicates what the costs to society would be without the investment. For example, failure to reclaim dryland saline soils generally will result in an expansion of the affected area and further reduction in production on affected farms. Therefore, although this alternative was shown to have one of the lowest AECF's and one of the lowest B/C ratios, there are other long-term economic justifications for investing in reclamation.

Sensitivity analysis did give some indication of the impact of subsidies and grants on the feasibility of alternatives examined. The main subsidies which applied to the analysis were land improvement and water development grants, crop insurance subsidies and specific grants such as the lime transport grant. Subsidies were found to make up from less than 10 per cent to 50 or 60 per cent of net returns. Many alternatives fell into the 10 to 25 per cent bracket, with the removal of subsidies not having a very significant impact on net returns. These alternatives included irrigation, range improvement (excluding the Brown soil zone), summerfallow reduction, deep plowing and range conversion. Woodland conversion, liming and reclamation of irrigated saline soils had a higher impact from subsidies of 30 per cent, while Green Area

conversion, drainage and reclamation of irrigated saline soils had the highest impacts of 40 to 60 per cent. Range conversion on Brown was not feasible without subsidies. It must be noted that only on-farm development subsidies were analysed in this study. Since off-farm infrastructure was not examined, any government subsidization of such infrastructure was not analysed.

In other instances, such as clearing bush for crops or range, or converting range to cropland, investments were shown to have reasonably high returns. Other factors such as soil conservation and environmental considerations may have a major impact on the decision to change the land use. Also, not considered in this study are the multiple problems such as dryland salinity and range conversion or drainage on newly cleared lands.

In conclusion, the results tabulated in Tables 84 to 93 can be used as guides to the relative economic and financial feasibility of different alternatives and to indicate where the greatest returns for investment dollars could be expected. Other factors beyond the scope of this study must be considered in the decision process. These include government expenditures on infrastructure and the impact on other resource users. An evaluation of these factors are the subject of later phases of the Agricultural Land Base Study.

APPENDICES

AGRICULTURAL LAND BASE STUDY

ECONOMIC AND FINANCIAL ANALYSIS: DIRECT BENEFITS AND COSTS

NUMBER #9

APPENDIX I A

ECONOMIC ANALYSIS: GREEN AREA CONVERSION

	NPV ($/acre)	B/C (ratio)	AECF ($/acre)
1. 7% Discount Rate			
a. 485 acres 1/4 - 3/4	31.17	1.04	2.03
b. 960 acres 1/4 - 3/4	119.54	1.17	7.78
c. 485 acres C/C	48.60	1.05	3.16
d. 960 acres C/C	134.19	1.16	8.73
2. 3% Discount Rate			
a. 485 acres 1/4 - 3/4	258.51	1.21	16.82
b. 960 acres 1/4 - 3/4	376.22	1.36	24.47
c. 485 acres C/C	288.67	1.19	18.78
d. 960 acres C/C	402.74	1.30	26.20
3. 10% Decrease in Prices or Yields			
a. 485 acres 1/4 - 3/4	12.11	1.01	0.79
b. 960 acres 1/4 - 3/4	115.76	1.14	7.53
c. 485 acres C/C	11.09	1.01	0.72
d. 960 acres C/C	112.49	1.11	7.32
4. 20% Decrease in Prices or Yields			
a. 485 acres 1/4 - 3/4	-98.17	0.90	-6.39
b. 960 acres 1/4 - 3/4	9.15	1.01	0.60
c. 485 acres C/C	-122.78	0.90	-7.99
d. 960 acres C/C	-16.80	0.98	-1.09
5. Investment Costs 10% Increase			
a. 485 acres 1/4 - 3/4	63.51	1.06	4.13
b. 960 acres 1/4 - 3/4	177.74	1.20	11.56
c. 485 acres C/C	85.58	1.07	5.57
d. 960 acres C/C	196.66	1.18	12.79

APPENDIX I A (continued)

ECONOMIC ANALYSIS: GREEN AREA CONVERSION

	NPV ($/acre)	B/C (ratio)	AECF ($/acre)
6. Production Costs 10% Increase			
a. 485 acres 1/4 - 3/4	83.92	1.08	5.46
b. 960 acres 1/4 - 3/4	183.30	1.21	11.92
c. 485 acres C/C	85.71	1.07	5.58
d. 960 acres C/C	182.50	1.16	11.87
7. New Equipment Costs			
a. 485 acres 1/4 - 3/4	-261.78	0.81	-17.03
b. 960 acres 1/4 - 3/4	-226.15	0.79	-14.71
c. 485 acres C/C	-239.17	0.85	-15.56
d. 960 acres C/C	0.00	1.00	0.00
8. Residual Value of Land Included			
a. 485 acres 1/4 - 3/4	282.80	1.29	18.40
b. 960 acres 1/4 - 3/4	409.46	1.48	26.64
c. 485 acres C/C	314.37	1.26	20.45
d. 960 acres C/C	437.76	1.41	28.48

APPENDIX I B

FINANCIAL ANALYSIS: GREEN AREA CONVERSION[1]
485 ACRES

Case	NPV ($/ acre)			AEF ($/ acre)			B/C (ratio)		
	Total Resources	After Fin.	After Fin&Tax	Total Resources	After Fin	After Fin&Tax	Total Resources	After Fin.	After Fin&Tax
No Equity									
Base Case (5%)	181.94	-404.14	-406.20	11.84	-26.29	-26.42	1.12	0.86	0.86
Discount rate 3%	418.26	-599.18	-602.84	21.34	-30.57	-30.76	1.22	0.84	0.84
Discount rate 7%	35.79	-281.02	-282.18	2.88	-22.65	-22.74	1.03	0.87	0.87
Discount rate 10%	-89.35	-172.92	-173.43	-9.48	-18.34	-18.40	0.91	0.89	0.89
10% Equity									
Base Case (5%)	176.23	-338.59	-340.20	11.46	-22.03	-22.13	1.12	0.87	0.87
Discount rate 3%	408.09	-493.68	-496.56	20.82	-25.19	-25.33	1.22	0.86	0.86
Discount rate 7%	32.55	-241.03	-241.95	2.62	-19.42	-19.50	1.03	0.89	0.89
Discount rate 10%	-90.76	-155.88	-156.28	-9.63	-16.54	-16.58	0.91	0.90	0.90
20% Equity									
Base Case (5%)	170.52	-273.03	-274.20	11.09	-17.76	-17.84	1.11	0.89	0.89
Discount rate 3%	397.92	-388.19	-390.28	20.30	-19.81	-19.91	1.21	0.88	0.88
Discount rate 7%	29.31	-201.05	-201.72	2.36	-16.20	-16.26	1.02	0.90	0.90
Discount rate 10%	-92.18	-138.84	-139.13	-9.78	-14.73	-14.76	0.91	0.91	0.91

1. Based on a 30-year project.

APPENDIX I B (continued)

FINANCIAL ANALYSIS: GREEN AREA CONVERSION[1]
485 ACRES

Case	NPV			AEF			B/C		
	Total Resources	After Fin.	After Fin&Tax	Total Resources	After Fin	After Fin&Tax	Total Resources	After Fin.	After Fin&Tax
	($/ acre)			($/ acre)			(ratio)		
30% Equity									
Base Case (5%)	164.81	-207.47	-208.21	10.72	-13.50	-13.54	1.11	0.91	0.91
Discount rate 3%	387.76	-282.69	-284.00	19.78	-14.42	-14.49	1.21	0.91	0.91
Discount rate 7%	26.07	-161.07	-161.49	2.10	-12.98	-13.01	1.02	0.92	0.91
Discount rate 10%	-93.59	-121.80	-121.98	-9.93	-12.92	-12.94	0.91	0.91	0.91
No Beginning Farmer Loan									
Base Case (5%)	181.94	-506.28	-508.88	11.84	-32.93	-33.10	1.12	0.83	0.83
Discount rate 3%	418.26	-708.90	-713.54	21.34	-36.17	-36.40	1.22	0.82	0.82
Discount rate 7%	35.79	-376.32	-377.80	2.88	-30.33	-30.45	1.03	0.84	0.84
Discount rate 10%	-89.35	-259.20	-259.84	-9.48	-27.50	-27.56	0.91	0.85	0.85
No Residual Value									
Base Case (5%)	124.83	-461.25	-461.25	8.12	-30.00	-30.00	1.08	0.84	0.84
Discount rate 3%	316.58	-700.86	-700.86	16.15	-35.76	-35.76	1.17	0.81	0.81
Discount rate 7%	3.37	-313.44	-313.44	0.27	-25.26	-25.26	1.00	0.86	0.86
Discount rate 10%	-103.49	-187.07	-187.07	-10.98	-19.84	-19.84	0.90	0.88	0.88

1. Based on a 30-year project.

APPENDIX I C

FINANCIAL ANALYSIS: GREEN AREA CONVERSION[1]
960 ACRES

Case	NPV ($/ acre)			AEF ($/ acre)			B/C (ratio)		
	Total Resources	After Fin.	After Fin&Tax	Total Resources	After Fin	After Fin&Tax	Total Resources	After Fin.	After Fin&Tax
No Equity									
Base Case (5%)	245.83	-268.60	-270.81	15.99	-17.50	-17.62	1.18	0.89	0.89
Discount rate 3%	485.05	-385.50	-389.52	24.75	-19.70	-19.87	1.29	0.88	0.88
Discount rate 7%	97.80	-193.50	-194.82	7.88	-15.60	-15.70	1.09	0.90	0.90
Discount rate 10%	-28.97	-126.40	-126.92	-3.07	-13.40	-13.46	0.97	0.91	0.91
10% Equity									
Base Case (5%)	239.91	-180.10	-181.99	15.61	-11.70	-11.84	1.18	0.92	0.92
Discount rate 3%	474.50	-237.40	-240.75	24.21	-12.10	-12.28	1.28	0.92	0.92
Discount rate 7%	94.44	-140.90	-141.98	7.61	-11.40	-11.44	1.09	0.92	0.92
Discount rate 10%	-30.44	-103.40	-103.92	-3.23	-11.00	-11.02	0.96	0.92	0.92
20% Equity									
Base Case (5%)	233.99	-91.60	-95.63	15.22	-6.00	-6.22	1.17	0.96	0.96
Discount rate 3%	463.96	-89.20	-96.29	23.67	-4.60	-4.91	1.27	0.97	0.97
Discount rate 7%	91.08	-88.30	-90.56	7.34	-7.10	-7.30	1.08	0.95	0.95
Discount rate 10%	-31.91	-80.50	-81.55	-3.38	-8.50	-8.65	0.96	0.94	0.94

1. Based on a 30-year project.

APPENDIX I C (continued)

FINANCIAL ANALYSIS: GREEN AREA CONVERSION[1]
960 ACRES

Case	NPV			AEF			B/C		
	Total Resources	After Fin.	After Fin&Tax	Total Resources	After Fin	After Fin&Tax	Total Resources	After Fin.	After Fin&Tax
	($/ acre)			($/ acre)			(ratio)		
30% Equity									
Base Case (5%)	228.07	-3.10	-15.79	14.84	-0.20	-1.03	1.17	1.00	0.99
Discount rate 3%	453.42	59.00	36.35	23.13	3.00	1.85	1.27	1.02	1.01
Discount rate 7%	87.72	-35.60	-42.63	7.07	-2.90	-3.44	1.08	0.98	0.97
Discount rate 10%	-33.37	-57.60	-60.36	-3.54	-6.10	-6.40	0.96	0.95	0.95
No Beginning Farmer Loan									
Base Case (5%)	245.83	-321.10	-323.63	15.99	-20.90	-21.05	1.18	0.87	0.87
Discount rate 3%	485.05	-441.60	-446.11	24.75	-22.50	-22.76	1.29	0.87	0.87
Discount rate 7%	97.80	-242.90	-244.31	7.88	-19.60	-19.69	1.09	0.88	0.88
Discount rate 10%	-28.97	-171.40	-172.03	-3.07	-18.20	-18.25	0.97	0.88	0.88
No Residual Value									
Base Case (5%)	186.63	-327.80	-330.01	12.14	-21.30	-21.47	1.14	0.87	0.87
Discount rate 3%	379.64	-490.90	-494.93	19.37	-25.00	-25.25	1.22	0.85	0.85
Discount rate 7%	64.19	-227.20	-228.43	5.17	-18.30	-18.41	1.06	0.88	0.88
Discount rate 10%	-43.64	-141.00	-141.58	-4.63	-15.00	-15.02	0.95	0.90	0.90

1. Based on a 30-year project.

APPENDIX II A

ECONOMIC ANALYSIS: IRRIGATION EXPANSION[1]

I. Intensification/Extension	NPV -($/acre)-	AECF	B/C (ratio)
1. Zone A1			
a. Base case	2 739	178	2.35
b. Discount rate 3%	3 759	192	2.41
c. Discount rate 7%	2 043	165	2.30
d. System costs +20%	2 644	172	2.28
e. Crop benefits -20%	1 786	116	1.88
f. Incremental costs +10%	2 584	168	2.19
g. Residual value included	2 842	185	2.40
2. Zone A2			
a. Base case	1 850	120	2.03
b. Discount rate 3%	2 559	131	2.09
c. Discount rate 7%	1 368	110	1.98
d. System costs +20%	1 755	114	1.93
e. Crop benefits -20%	1 122	73	1.63
f. Incremental costs +10%	1 719	112	1.90
g. Residual value included	1 953	127	2.09
3. Zone B			
a. Base case	1 503	98	1.93
b. Discount rate 3%	2 090	107	1.99
c. Discount rate 7%	1 104	89	1.87
d. System costs +20%	1 508	98	1.82
e. Crop benefits -20%	879	57	1.54
f. Incremental costs +10%	1 389	90	1.80
g. Residual value included	1 606	104	1.99
4. Zone C			
a. Base case	872	57	1.64
b. Discount rate 3%	1 239	63	1.70
c. Discount rate 7%	625	50	1.59
d. System costs +10%	877	57	1.53
e. Crop benefits -20%	426	28	1.31
f. Incremental costs +10%	784	51	1.54
g. Residual value included	975	65	1.72

1. Based on a discount rate of 5 per cent and on 10 000 acre blocks.

APPENDIX II A (continued)

ECONOMIC ANALYSIS: IRRIGATION EXPANSION

II. Expansion	NPV -($/acre)-	AECF	B/C (ratio)
1. Zone A1			
a. Base case	1 998	130	2.33
b. Discount rate 3%	2 844	145	2.37
c. Discount rate 7%	1 438	116	2.28
d. System costs +20%	1 924	125	2.22
e. Crop benefits -20%	1 296	84	1.86
f. Incremental costs +10%	1 883	123	2.16
g. Residual value included	2 100	136	2.39
2. Zone A2			
a. Base case	1 344	87	2.01
b. Discount rate 3%	1 926	98	2.06
c. Discount rate 7%	959	77	1.96
d. System costs +20%	1 271	83	1.90
e. Crop benefits -20%	809	53	1.61
f. Incremental costs +10%	1 248	81	1.87
g. Residual value included	1 447	94	2.09
3. Zone B			
a. Base case	1 089	71	1.90
b. Discount rate 3%	1 569	80	1.95
c. Discount rate 7%	772	62	1.85
d. System costs +20%	1 015	66	1.79
e. Crop benefits -20%	629	41	1.52
f. Incremental costs +10%	1 004	65	1.78
g. Residual value included	1 191	77	1.99
4. Zone C			
a. Base case	625	41	1.62
b. Discount rate 3%	918	47	1.67
c. Discount rate 7%	433	35	1.56
d. System costs +20%	551	36	1.51
e. Crop benefits -20%	296	19	1.29
f. Incremental costs +10%	559	36	1.52
g. Residual value included	727	47	1.71

APPENDIX II B

FINANCIAL ANALYSIS:
IRRIGATION INTENSIFICATION ZONE A1

Case	B/C Ratio	AECF ($/ac)	NPV ($/ac)
5% Discount Rate			
Before Financing	2.13	175.26	2 694.17
After Financing	1.80	160.92	2 473.68
After Fin. & Tax (20%)	1.56	129.32	1 987.96
Tax Rate (30%)	1.46	113.52	1 745.10
7% Discount Rate			
Before Financing	2.04	156.97	1 947.80
After Financing	1.74	145.24	1 802.32
After Fin. & Tax (20%)	1.52	116.37	1 444.09
Tax Rate (30%)	1.43	101.94	1 264.97
10% Discount Rate			
Before Financing	1.91	132.39	1 248.05
After Financing	1.67	124.49	1 173.55
After Fin. & Tax (20%)	1.47	99.36	936.67
Tax Rate (30%)	1.39	86.80	818.22
50% Discount Rate			
Before Financing	1.07	6.41	12.82
After Financing	1.20	21.16	42.33
After Fin. & Tax (20%)	1.14	15.99	31.99
Tax Rate (30%)	1.12	13.41	26.82
No Residual Value			
Before Financing	2.07	166.85	2 564.85
After Financing	1.76	152.50	2 344.36
After Fin. & Tax (20%)	1.53	121.75	1 871.57
Tax Rate (30%)	1.43	106.37	1 635.17
With Land Cost			
Before Financing	1.74	140.63	2 161.87
After Financing	1.54	126.29	1 941.38
After Fin. & Tax (20%)	1.36	95.53	1 468.59
Tax Rate (30%)	1.28	80.16	1 232.19

APPENDIX II C

FINANCIAL ANALYSIS:
IRRIGATION INTENSIFICATION ZONE A2

Case	B/C Ratio	AECF ($/ac)	NPV ($/ac)
5% Discount Rate			
Before Financing	1.85	117.10	1 800.06
After Financing	1.56	102.75	1 579.58
After Fin. & Tax (20%)	1.41	82.31	1 265.33
Tax Rate (30%)	1.34	72.09	1 108.21
7% Discount Rate			
Before Financing	1.77	103.05	1 278.80
After Financing	1.51	91.33	1 133.32
After Fin. & Tax (20%)	1.37	72.82	903.59
Tax Rate (30%)	1.31	63.56	785.72
10% Discount Rate			
Before Financing	1.65	84.16	793.41
After Financing	1.45	76.26	718.92
After Fin. & Tax (20%)	1.32	60.38	569.20
Tax Rate (30%)	1.27	52.44	494.35
50% Discount Rate			
Before Financing	0.86	-12.24	-24.49
After Financing	1.02	2.51	5.01
After Fin. & Tax (20%)	1.00	0.11	0.23
Tax Rate (30%)	0.99	-1.08	-2.17
No Residual Value			
Before Financing	1.82	112.11	1 723.47
After Financing	1.54	97.77	1 502.99
After Fin. & Tax (20%)	1.38	77.83	1 196.40
Tax Rate (30%)	1.32	67.86	1 043.11
With Land Cost			
Before Financing	1.61	96.59	1 484.82
After Financing	1.40	82.25	1 264.33
After Fin. & Tax (20%)	1.28	62.30	957.74
Tax Rate (30%)	1.22	52.33	804.45

APPENDIX II D

FINANCIAL ANALYSIS:
IRRIGATION INTENSIFICATION ZONE B

Case	B/C Ratio	AECF ($/ac)	NPV ($/ac)
5% Discount Rate			
Before Financing	1.77	93.96	1 444.35
After Financing	1.47	79.61	1 223.87
After Fin. & Tax (20%)	1.35	63.54	976.75
Tax Rate (30%)	1.29	55.50	853.19
7% Discount Rate			
Before Financing	1.69	82.80	1 027.50
After Financing	1.43	71.08	882.02
After Fin. & Tax (20%)	1.32	56.53	701.53
Tax Rate (30%)	1.27	49.26	611.29
10% Discount Rate			
Before Financing	1.58	67.53	636.58
After Financing	1.38	59.63	562.09
After Fin. & Tax (20%)	1.28	47.19	444.90
Tax Rate (30%)	1.23	40.98	386.31
50% Discount Rate			
Before Financing	0.85	-11.23	-22.47
After Financing	1.04	3.52	7.03
After Fin. & Tax (20%)	1.02	1.99	3.98
Tax Rate (30%)	1.01	1.22	2.45
No Residual Value			
Before Financing	1.76	93.09	1 431.02
After Financing	1.47	78.75	1 210.54
After Fin. & Tax (20%)	1.34	62.76	964.75
Tax Rate (30%)	1.29	54.76	841.85
With Land Cost			
Before Financing	1.72	90.39	1 389.47
After Financing	1.44	76.04	1 168.99
After Fin. & Tax (20%)	1.32	60.06	923.20
Tax Rate (30%)	1.27	52.06	800.31

APPENDIX II E

FINANCIAL ANALYSIS:
IRRIGATION INTENSIFICATION ZONE C

Case	B/C Ratio	AECF ($/ac)	NPV ($/ac)
5% Discount Rate			
Before Financing	1.56	57.00	876.23
After Financing	1.29	42.66	655.75
After Fin. & Tax (20%)	1.22	34.02	522.94
Tax Rate (30%)	1.19	29.70	456.53
7% Discount Rate			
Before Financing	1.48	48.38	600.34
After Financing	1.26	36.66	454.86
After Fin. & Tax (20%)	1.19	29.05	360.44
Tax Rate (30%)	1.16	25.24	313.23
10% Discount Rate			
Before Financing	1.38	36.75	346.46
After Financing	1.21	28.85	271.97
After Fin. & Tax (20%)	1.16	22.64	213.41
Tax Rate (30%)	1.13	19.53	184.13
50% Discount Rate			
Before Financing	0.71	-18.91	-37.82
After Financing	0.95	-4.16	-8.32
After Fin. & Tax (20%)	0.95	-3.94	-7.88
Tax Rate (30%)	0.95	-3.83	-7.66
No Residual Value			
Before Financing	1.55	55.98	860.62
After Financing	1.28	41.64	640.14
After Fin. & Tax (20%)	1.21	33.10	508.89
Tax Rate (30%)	1.18	28.84	443.27
With Land Cost			
Before Financing	1.50	52.82	811.98
After Financing	1.25	38.48	591.50
After Fin. & Tax (20%)	1.19	29.94	460.25
Tax Rate (30%)	1.16	25.67	394.63

APPENDIX II F

FINANCIAL ANALYSIS:
IRRIGATION INTENSIFICATION ZONE D

Case	B/C Ratio	AECF ($/ac)	NPV ($/ac)
5% Discount Rate			
Before Financing	1.81	82.40	1 266.77
After Financing	1.46	68.06	1 046.28
After Fin. & Tax (20%)	1.34	54.34	835.37
Tax Rate (30%)	1.28	47.48	729.91
7% Discount Rate			
Before Financing	1.73	72.29	897.02
After Financing	1.42	60.56	751.54
After Fin. & Tax (20%)	1.31	48.17	597.78
Tax Rate (30%)	1.26	41.98	520.91
10% Discount Rate			
Before Financing	1.61	58.48	551.30
After Financing	1.37	50.58	476.80
After Fin. & Tax (20%)	1.27	40.02	377.27
Tax Rate (30%)	1.23	34.74	327.51
50% Discount Rate			
Before Financing	0.82	-11.38	-22.77
After Financing	1.04	3.37	6.73
After Fin. & Tax (20%)	1.02	2.08	4.16
Tax Rate (30%)	1.02	1.44	2.88
No Residual Value			
Before Financing	1.80	81.39	1 251.16
After Financing	1.46	67.05	1 030.67
After Fin. & Tax (20%)	1.33	53.43	821.32
Tax Rate (30%)	1.28	46.62	716.64
With Land Cost			
Before Financing	1.74	78.23	1 202.52
After Financing	1.42	63.88	982.04
After Fin. & Tax (20%)	1.31	50.26	772.68
Tax Rate (30%)	1.25	43.45	668.00

APPENDIX II G

FINANCIAL ANALYSIS:
IRRIGATION EXPANSION ZONE A1

Case	B/C Ratio	AECF ($/ac)	NPV ($/ac)
5% Discount Rate			
Before Financing	2.13	131.28	2 018.12
After Financing	1.81	121.47	1 867.30
After Fin. & Tax (20%)	1.57	97.90	1 504.92
Tax Rate (30%)	1.47	86.11	1 323.74
7% Discount Rate			
Before Financing	2.04	113.12	1 403.77
After Financing	1.75	105.36	1 307.38
After Fin. & Tax (20%)	1.53	84.60	1 049.86
Tax Rate (30%)	1.43	74.23	921.09
10% Discount Rate			
Before Financing	1.92	90.18	850.10
After Financing	1.67	85.20	803.19
After Fin. & Tax (20%)	1.47	68.07	641.68
Tax Rate (30%)	1.39	59.50	560.92
50% Discount Rate			
Before Financing	1.02	0.98	1.96
After Financing	1.15	8.52	17.04
After Fin. & Tax (20%)	1.10	5.77	11.54
Tax Rate (30%)	1.07	4.40	8.79
No Residual Value			
Before Financing	2.06	123.18	1 893.61
After Financing	1.76	113.37	1 742.79
After Fin. & Tax (20%)	1.53	90.61	1 392.87
Tax Rate (30%)	1.43	79.23	1 217.91
With Land Cost			
Before Financing	1.66	97.94	1 505.63
After Financing	1.48	88.13	1 354.81
After Fin. & Tax (20%)	1.32	65.37	1 004.89
Tax Rate (30%)	1.25	53.99	829.93

APPENDIX II H

FINANCIAL ANALYSIS:
IRRIGATION EXPANSION ZONE A2

Case	B/C Ratio	AECF ($/ac)	NPV ($/ac)
5% Discount Rate			
Before Financing	1.85	87.42	1 343.83
After Financing	1.57	77.61	1 193.00
After Fin. & Tax (20%)	1.41	62.33	958.15
Tax Rate (30%)	1.34	54.69	840.72
7% Discount Rate			
Before Financing	1.76	73.96	917.75
After Financing	1.52	66.19	821.37
After Fin. & Tax (20%)	1.37	52.84	655.74
Tax Rate (30%)	1.31	46.17	572.93
10% Discount Rate			
Before Financing	1.64	56.92	536.54
After Financing	1.45	51.94	489.64
After Fin. & Tax (20%)	1.32	41.06	387.09
Tax Rate (30%)	1.27	35.62	335.81
50% Discount Rate			
Before Financing	0.78	-10.90	-21.80
After Financing	0.94	-3.37	-6.73
After Fin. & Tax (20%)	0.92	-4.69	-9.38
Tax Rate (30%)	0.91	-5.36	-10.71
No Residual Value			
Before Financing	1.81	82.75	1 272.06
After Financing	1.54	72.94	1 121.23
After Fin. & Tax (20%)	1.38	58.13	893.55
Tax Rate (30%)	1.32	50.72	779.72
With Land Cost			
Before Financing	1.56	68.20	1 048.40
After Financing	1.38	58.39	897.58
After Fin. & Tax (20%)	1.26	43.58	669.90
Tax Rate (30%)	1.20	36.17	556.06

APPENDIX II I

FINANCIAL ANALYSIS:
IRRIGATION EXPANSION ZONE B

Case	B/C Ratio	AECF ($/ac)	NPV ($/ac)
5% Discount Rate			
Before Financing	1.76	69.51	1 068.53
After Financing	1.48	59.70	917.71
After Fin. & Tax (20%)	1.35	47.74	733.90
Tax Rate (30%)	1.29	41.76	641.99
7% Discount Rate			
Before Financing	1.69	59.07	733.01
After Financing	1.44	51.30	636.62
After Fin. & Tax (20%)	1.32	40.85	506.93
Tax Rate (30%)	1.27	35.63	442.08
10% Discount Rate			
Before Financing	1.58	45.68	430.58
After Financing	1.38	40.70	383.68
After Fin. & Tax (20%)	1.28	32.19	303.48
Tax Rate (30%)	1.23	27.94	263.38
50% Discount Rate			
Before Financing	0.81	-7.78	-15.56
After Financing	1.00	-0.24	-0.48
After Fin. & Tax (20%)	0.98	-1.13	-2.25
Tax Rate (30%)	0.97	-1.57	-3.14
No Residual Value			
Before Financing	1.75	68.96	1 060.01
After Financing	1.47	59.14	909.19
After Fin. & Tax (20%)	1.34	47.24	726.23
Tax Rate (30%)	1.29	41.29	634.75
With Land Cost			
Before Financing	1.72	67.23	1 033.47
After Financing	1.45	57.42	882.64
After Fin. & Tax (20%)	1.33	45.52	699.68
Tax Rate (30%)	1.27	39.56	608.21

APPENDIX II J

FINANCIAL ANALYSIS:
IRRIGATION EXPANSION ZONE C

Case	B/C Ratio	AECF ($/ac)	NPV ($/ac)
5% Discount Rate			
Before Financing	1.56	42.41	651.89
After Financing	1.30	32.60	501.07
After Fin. & Tax (20%)	1.22	26.10	401.27
Tax Rate (30%)	1.19	22.86	351.38
7% Discount Rate			
Before Financing	1.48	34.77	431.52
After Financing	1.26	27.01	335.14
After Fin. & Tax (20%)	1.20	21.47	266.38
Tax Rate (30%)	1.17	18.70	232.01
10% Discount Rate			
Before Financing	1.38	25.13	236.87
After Financing	1.21	20.15	189.97
After Fin. & Tax (20%)	1.16	15.82	149.11
Tax Rate (30%)	1.14	13.65	128.68
50% Discount Rate			
Before Financing	0.68	-11.19	-22.38
After Financing	0.92	-3.65	-7.30
After Fin. & Tax (20%)	0.92	-3.64	-7.28
Tax Rate (30%)	0.92	-3.64	-7.27
No Residual Value			
Before Financing	1.55	41.70	641.10
After Financing	1.29	31.89	490.28
After Fin. & Tax (20%)	1.22	25.47	391.56
Tax Rate (30%)	1.19	22.26	342.20
With Land Cost			
Before Financing	1.50	39.52	607.47
After Financing	1.26	29.71	456.64
After Fin. & Tax (20%)	1.20	23.28	357.93
Tax Rate (30%)	1.16	20.07	308.57

APPENDIX II K

FINANCIAL ANALYSIS:
IRRIGATION EXPANSION ZONE D

Case	B/C Ratio	AECF ($/ac)	NPV ($/ac)
5% Discount Rate			
Before Financing	1.81	61.09	939.13
After Financing	1.47	51.28	788.31
After Fin. & Tax (20%)	1.34	41.05	631.06
Tax Rate (30%)	1.29	35.94	552.44
7% Discount Rate			
Before Financing	1.72	51.71	641.69
After Financing	1.43	43.94	545.31
After Fin. & Tax (20%)	1.31	35.02	434.52
Tax Rate (30%)	1.26	30.55	379.13
10% Discount Rate			
Before Financing	1.60	39.72	374.40
After Financing	1.37	34.74	327.49
After Fin. & Tax (20%)	1.27	27.49	259.13
Tax Rate (30%)	1.23	23.86	224.95
50% Discount Rate			
Before Financing	0.79	-7.34	-14.67
After Financing	1.00	0.20	0.40
After Fin. & Tax (20%)	0.99	-0.56	-1.12
Tax Rate (30%)	0.98	-0.94	-1.88
No Residual Value			
Before Financing	1.80	60.39	928.34
After Financing	1.46	50.58	777.51
After Fin. & Tax (20%)	1.34	40.42	621.35
Tax Rate (30%)	1.28	35.34	543.27
With Land Cost			
Before Financing	1.74	58.20	894.70
After Financing	1.43	48.39	743.88
After Fin. & Tax (20%)	1.31	38.23	587.72
Tax Rate (30%)	1.26	33.15	509.63

APPENDIX III A

ECONOMIC ANALYSIS: PARTIAL DRAINAGE NO RESIDUAL VALUE[1]

| | NPV | AECF | B/C |
---	---	---($/acre)---	(ratio)
1. Peace			
a. Base case 5%	482.0	31.4	1.51
b. Discount rate 3%	756.9	38.6	1.67
c. Discount rate 7%	293.8	23.7	1.36
d. Discount rate 10%	111.4	11.8	1.17
e. Crop benefits -20%	248.8	16.2	1.26
f. Incremental costs +20%	396.0	25.8	1.39
2. Athabasca			
a. Base case 5%	337.5	22.0	1.32
b. Discount rate 3%	590.4	30.1	1.48
c. Discount rate 7%	165.3	13.3	1.18
d. Discount rate 10%	-0.2	0.0	1.00
e. Crop benefits -20%	104.7	6.8	1.10
f. Incremental costs +20%	253.2	16.5	1.23
3. Beaver			
a. Base case 5%	250.4	16.3	1.23
b. Discount rate 3%	491.9	25.1	1.38
c. Discount rate 7%	86.7	7.0	1.09
d. Discount rate 10%	-69.7	-7.4	0.91
e. Crop benefits -20%	18.8	1.2	1.02
f. Incremental costs +20%	166.5	10.8	1.14
4. North Saskatchewan			
a. Base case 5%	770.3	50.1	1.63
b. Discount rate 3%	1 189.1	60.7	1.82
c. Discount rate 7%	483.0	38.9	1.45
d. Discount rate 10%	203.2	21.6	1.22
e. Crop benefits -20%	536.0	34.9	1.44
f. Incremental costs +20%	674.4	43.9	1.51
5. Battle			
a. Base case 5%	903.5	58.8	1.70
b. Discount rate 3%	1 374.3	70.1	1.91
c. Discount rate 7%	580.0	46.7	1.52
d. Discount rate 10%	264.4	28.0	1.28
e. Crop benefits -20%	668.8	43.5	1.52
f. Incremental costs +20%	804.0	52.3	1.58

1. Based on a project life of 30 years (Scenario 2).

APPENDIX III B

ECONOMIC ANALYSIS: PARTIAL DRAINAGE WITH RESIDUAL VALUE[1]

	NPV	AECF	B/C
	-------($/acre)-------		(ratio)
1. Peace			
a. Base case 5%	575.5	37.4	1.61
b. Discount rate 3%	923.5	47.1	1.82
c. Discount rate 7%	346.9	28.0	1.43
d. Discount rate 10%	134.6	14.3	1.20
e. Crop benefits -20%	342.4	22.3	1.36
f. Incremental costs +20%	489.5	31.8	1.48
2. Athabasca			
a. Base case 5%	449.4	29.2	1.43
b. Discount rate 3%	789.7	40.3	1.64
c. Discount rate 7%	228.8	18.4	1.25
d. Discount rate 10%	27.5	2.9	1.04
e. Crop benefits -20%	216.6	14.1	1.21
f. Incremental costs +20%	365.1	23.7	1.33
3. Beaver			
a. Base case 5%	374.6	24.4	1.34
b. Discount rate 3%	713.0	36.4	1.55
c. Discount rate 7%	157.2	12.7	1.16
d. Discount rate 10%	-38.9	-4.1	0.95
e. Crop benefits -20%	143.0	9.3	1.13
f. Incremental costs +20%	290.7	18.9	1.24
4. North Saskatchewan			
a. Base case 5%	906.6	59.0	1.74
b. Discount rate 3%	1 431.7	73.0	1.99
c. Discount rate 7%	560.3	45.2	1.53
d. Discount rate 10%	236.9	25.1	1.26
e. Crop benefits -20%	672.3	43.7	1.55
f Incremental costs +20%	810.7	52.7	1.61
5. Battle			
a. Base case 5%	1 048.1	68.2	1.82
b. Discount rate 3%	1 631.8	83.3	2.08
c. Discount rate 7%	662.1	53.4	1.59
d. Discount rate 10%	300.2	31.8	1.32
e. Crop benefits -20%	813.4	52.9	1.63
f. Incremental costs +20%	948.6	61.7	1.68

1. Based on a project life of 30 years (Scenario 2).

APPENDIX III C

ECONOMIC ANALYSIS: FULL DRAINAGE NO RESIDUAL[1]

	NPV	AECF	B/C
	------($/acre)------		(ratio)
1. Peace			
a. Base case 5%	336.9	21.9	1.40
b. Discount rate 3%	572.1	29.2	1.57
c. Discount rate 7%	178.6	14.4	1.25
d. Discount rate 10%	29.0	3.1	1.05
e. Crop benefits -20%	142.2	9.3	1.17
f. Incremental costs +20%	258.2	16.8	1.28
2. Athabasca			
a. Base case 5%	192.3	12.5	1.22
b. Discount rate 3%	397.2	20.3	1.38
c. Discount rate 7%	56.3	4.5	1.07
d. Discount rate 10%	-69.6	-7.4	0.89
e. Crop benefits -20%	5.3	0.3	1.01
f. Incremental costs +20%	114.8	7.5	1.12
3. Beaver			
a. Base case 5%	148.6	9.7	1.16
b. Discount rate 3%	347.5	17.7	1.32
c. Discount rate 7%	17.1	1.4	1.02
d. Discount rate 10%	-103.6	-11.0	0.84
e. Crop benefits -20%	-36.7	-2.4	0.96
f. Incremental costs +20%	71.7	4.7	1.07
4. North Saskatchewan			
a. Base case 5%	475.2	30.9	1.37
b. Discount rate 3%	830.3	42.4	1.55
c. Discount rate 7%	233.9	18.9	1.21
d. Discount rate 10%	2.4	0.3	1.00
e. Crop benefits -20%	256.3	16.7	1.20
f. Incremental costs +20%	382.8	24.9	1.28
5. Battle			
a. Base case 5%	561.7	36.5	1.39
b. Discount rate 3%	963.6	49.2	1.58
c. Discount rate 7%	287.6	23.2	1.23
d. Discount rate 10%	23.2	2.5	1.02
e. Crop benefits -20%	332.8	21.6	1.23
f. Incremental costs +20%	464.7	30.2	1.31

1. Based on a project life of 30 years (Scenario 1).

APPENDIX III D

ECONOMIC ANALYSIS: FULL DRAINAGE WITH RESIDUAL[1]

	NPV	AECF	B/C
	($/acre)		(ratio)
1. Peace			
a. Base case 5%	438.0	28.5	1.52
b. Discount rate 3%	752.1	38.4	1.74
c. Discount rate 7%	236.0	19.0	1.32
d. Discount rate 10%	54.0	5.7	1.09
e. Crop benefits -20%	243.3	15.8	1.29
f. Incremental costs +20%	359.3	23.4	1.39
2. Athabasca			
a. Base case 5%	307.0	20.0	1.35
b. Discount rate 3%	601.3	30.7	1.57
c. Discount rate 7%	121.4	9.8	1.16
d. Discount rate 10%	-41.2	-4.4	0.94
e. Crop benefits -20%	120.0	7.8	1.14
f. Incremental costs +20%	229.5	14.9	1.24
3. Beaver			
a. Base case 5%	269.4	17.5	1.30
b. Discount rate 3%	562.5	28.7	1.52
c. Discount rate 7%	85.6	6.9	1.11
d. Discount rate 10%	-73.7	-7.8	0.89
e. Crop benefits -20%	84.0	5.5	1.09
f. Incremental costs +20%	192.4	12.5	1.20
4. North Saskatchewan			
a. Base case 5%	636.1	41.4	1.49
b. Discount rate 3%	1 116.6	57.0	1.74
c. Discount rate 7%	325.2	26.2	1.29
d. Discount rate 10%	42.3	4.5	1.04
e. Crop benefits -20%	417.1	27.1	1.32
f. Incremental costs +20%	543.6	35.4	1.39
5. Battle			
a. Base case 5%	737.5	48.0	1.52
b. Discount rate 3%	1 276.6	65.1	1.77
c. Discount rate 7%	387.4	31.2	1.31
d. Discount rate 10%	66.7	7.1	1.06
e. Crop benefits -20%	508.6	33.1	1.36
f. Incremental costs +20%	640.5	41.7	1.42

1. Based on a project life of 30 years (Scenario 1).

APPENDIX III E

FINANCIAL ANALYSIS: PARTIAL DRAINAGE - PEACE[1]

Case	B/C Ratio	AECF ($/ac)	NPV ($/ac)
5% Discount Rate			
Before Financing	1.8	36.1	554.2
After Financing	1.5	31.4	482.3
After Financing & Tax (20%)	1.4	26.8	412.4
Tax Rate (30%)	1.3	24.6	377.5
3% Discount Rate			
Before Financing	2.0	46.2	905.2
After Financing	1.6	40.2	787.3
After Financing & Tax (20%)	1.4	33.6	657.9
Tax Rate (30%)	1.4	30.3	593.2
7% Discount Rate			
Before Financing	1.6	26.1	324.5
After Financing	1.4	23.4	290.7
After Financing & Tax (20%)	1.3	20.9	259.8
Tax Rate (30%)	1.2	19.7	244.4
10% Discount Rate			
Before Financing	1.3	11.9	112.2
After Financing	1.3	13.2	124.0
After Financing & Tax (20%)	1.2	13.7	129.0
Tax Rate (30%)	1.2	13.9	131.4
No Residual Value (5%)			
Before Financing	1.7	30.0	460.7
After Financing	1.4	25.3	388.7
After Financing & Tax (20%)	1.3	21.4	328.2
Tax Rate (30%)	1.2	19.4	298.0
No Residual Value (10%)			
Before Financing	1.3	9.4	89.0
After Financing	1.2	10.7	100.8
After Financing & Tax (20%)	1.2	11.5	108.1
Tax Rate (30%)	1.2	11.9	111.7

1. Scenario 2.

APPENDIX III F

FINANCIAL ANALYSIS: PARTIAL DRAINAGE - ATHABASCA[1]

	Case	B/C Ratio	AECF ($/ac)	NPV ($/ac)
5%	Discount Rate			
	Before Financing	1.5	27.9	428.2
	After Financing	1.3	22.7	348.6
	After Financing & Tax (20%)	1.2	20.2	310.7
	Tax Rate (30%)	1.2	19.0	291.7
3%	Discount Rate			
	Before Financing	1.8	39.4	771.5
	After Financing	1.4	32.5	637.2
	After Financing & Tax (20%)	1.3	27.7	543.3
	Tax Rate (30%)	1.3	25.3	496.4
7%	Discount Rate			
	Before Financing	1.3	16.7	206.7
	After Financing	1.2	13.9	172.3
	After Financing & Tax (20%)	1.2	13.7	170.5
	Tax Rate (30%)	1.1	13.7	169.5
10%	Discount Rate			
	Before Financing	1.1	0.6	5.6
	After Financing	1.1	2.7	25.2
	After Financing & Tax (20%)	1.1	5.9	55.7
	Tax Rate (30%)	1.1	7.5	71.0
No Residual Value (5%)				
	Before Financing	1.4	20.6	316.4
	After Financing	1.2	15.4	236.7
	After Financing & Tax (20%)	1.2	13.7	210.0
	Tax Rate (30%)	1.2	12.8	196.6
No Residual Value (10%)				
	Before Financing	1.0	-2.4	-22.2
	After Financing	1.0	-0.3	-2.5
	After Financing & Tax (20%)	1.0	3.3	30.8
	Tax Rate (30%)	1.1	5.0	47.4

1. Scenario 2.

APPENDIX III G

FINANCIAL ANALYSIS: PARTIAL DRAINAGE - BEAVER[1]

Case	B/C Ratio	AECF ($/ac)	NPV ($/ac)
5% Discount Rate			
Before Financing	1.4	23.0	353.3
After Financing	1.2	17.2	264.9
After Financing & Tax (20%)	1.1	16.1	247.2
Tax Rate (30%)	1.1	15.5	238.4
3% Discount Rate			
Before Financing	1.6	35.4	694.4
After Financing	1.3	27.8	545.5
After Financing & Tax (20%)	1.2	24.2	473.6
Tax Rate (30%)	1.2	22.3	437.7
7% Discount Rate			
Before Financing	1.2	10.9	135.0
After Financing	1.1	7.8	96.9
After Financing & Tax (20%)	1.1	9.2	113.7
Tax Rate (30%)	1.1	9.8	122.0
10% Discount Rate			
Before Financing	0.9	-6.5	-60.9
After Financing	1.0	-4.1	-39.0
After Financing & Tax (20%)	1.0	0.9	8.2
Tax Rate (30%)	1.0	3.4	31.8
No Residual Value (5%)			
Before Financing	1.2	14.9	229.1
After Financing	1.1	9.2	140.8
After Financing & Tax (20%)	1.1	8.8	135.5
Tax Rate (30%)	1.1	8.6	132.8
No Residual Value (10%)			
Before Financing	0.9	-9.7	-91.6
After Financing	1.0	-7.0	-69.8
After Financing & Tax (20%)	1.0	-2.1	-19.5
Tax Rate (30%)	1.0	0.6	5.6

1. Scenario 2.

APPENDIX III H

FINANCIAL ANALYSIS: PARTIAL DRAINAGE - NORTH SASKATCHEWAN[1]

	Case	B/C Ratio	AECF ($/ac)	NPV ($/ac)
5%	Discount Rate			
	Before Financing	1.8	57.4	881.8
	After Financing	1.4	45.3	696.6
	After Financing & Tax (20%)	1.3	38.8	596.1
	Tax Rate (30%)	1.3	35.5	545.9
3%	Discount Rate			
	Before Financing	2.2	71.9	1 410.0
	After Financing	1.6	58.8	1 153.2
	After Financing & Tax (20%)	1.4	49.2	963.5
	Tax Rate (30%)	1.4	44.3	868.6
7%	Discount Rate			
	Before Financing	1.6	43.1	534.6
	After Financing	1.3	33.0	409.3
	After Financing & Tax (20%)	1.2	29.6	367.4
	Tax Rate (30%)	1.2	27.9	346.5
10%	Discount Rate			
	Before Financing	1.3	22.4	211.5
	After Financing	1.1	16.9	158.9
	After Financing & Tax (20%)	1.1	18.1	170.8
	Tax Rate (30%)	1.1	18.8	176.8
No Residual Value (5%)				
	Before Financing	1.7	48.5	745.6
	After Financing	1.3	36.5	560.4
	After Financing & Tax (20%)	1.3	5.7	86.9
	Tax Rate (30%)	1.2	28.0	430.1
No Residual Value (10%)				
	Before Financing	1.2	18.9	177.8
	After Financing	1.1	13.3	125.2
	After Financing & Tax (20%)	1.0	-1.6	-15.3
	Tax Rate (30%)	1.1	15.7	148.2

1. Scenario 2.

APPENDIX III I

FINANCIAL ANALYSIS: PARTIAL DRAINAGE - BATTLE[1]

	Case	B/C Ratio	AECF ($/ac)	NPV ($/ac)
5%	Discount Rate			
	Before Financing	1.9	66.5	1 022.6
	After Financing	1.4	52.3	804.1
	After Financing & Tax (20%)	1.3	44.5	684.5
	Tax Rate (30%)	1.3	40.6	624.8
3%	Discount Rate			
	Before Financing	2.3	82.1	1 609.7
	After Financing	1.4	67.0	1 313.9
	After Financing & Tax (20%)	1.3	55.8	1 094.6
	Tax Rate (30%)	1.4	50.3	984.9
7%	Discount Rate			
	Before Financing	1.7	51.2	635.4
	After Financing	1.3	38.8	481.8
	After Financing & Tax (20%)	1.2	34.5	427.9
	Tax Rate (30%)	1.2	32.3	401.0
10%	Discount Rate			
	Before Financing	1.3	29.0	273.7
	After Financing	1.1	21.1	199.0
	After Financing & Tax (20%)	1.1	21.8	205.7
	Tax Rate (30%)	1.1	22.2	209.1
No Residual Value (5%)				
	Before Financing	1.8	57.1	878.0
	After Financing	1.3	42.9	659.5
	After Financing & Tax (20%)	1.3	36.1	554.4
	Tax Rate (30%)	1.2	36.7	501.9
No Residual Value (10%)				
	Before Financing	1.3	25.2	237.9
	After Financing	1.1	17.3	163.2
	After Financing & Tax (20%)	1.1	18.4	173.5
	Tax Rate (30%)	1.1	19.0	178.7

1. Scenario 2.

APPENDIX III J

FINANCIAL ANALYSIS: FULL DRAINAGE - PEACE[1]

	Case	B/C Ratio	ACEF ($/ac)	NPV ($/ac)
5%	Discount Rate			
	Before Financing	1.6	27.2	418.3
	After Financing	1.2	17.9	274.8
	After Financing & Tax (20%)	1.2	16.1	247.8
	Tax Rate (30%)	1.2	15.2	234.3
3%	Discount Rate			
	Before Financing	1.8	37.5	735.0
	After Financing	1.4	27.4	536.2
	After Financing & Tax (20%)	1.3	23.4	459.0
	Tax Rate (30%)	1.3	21.4	420.4
7%	Discount Rate			
	Before Financing	1.3	17.4	215.6
	After Financing	1.1	9.4	117.2
	After Financing & Tax (20%)	1.1	9.8	122.0
	Tax Rate (30%)	1.1	10.0	124.3
10%	Discount Rate			
	Before Financing	1.1	3.6	34.2
	After Financing	1.0	-1.2	-11.2
	After Financing & Tax (20%)	1.0	2.2	21.0
	Tax Rate (30%)	1.0	3.9	37.1
No Residual Value (5%)				
	Before Financing	1.4	20.6	317.2
	After Financing	1.2	11.3	173.7
	After Financing & Tax (20%)	1.1	10.2	156.8
	Tax Rate (30%)	1.1	9.7	148.4
No Residual Value (10%)				
	Before Financing	1.0	1.0	9.1
	After Financing	1.0	-3.9	-36.3
	After Financing & Tax (20%)	1.0	-0.2	-1.6
	Tax Rate (30%)	1.0	1.8	15.8

1. Scenario 1.

APPENDIX III K

FINANCIAL ANALYSIS: FULL DRAINAGE - ATHABASCA[1]

	Case	B/C Ratio	AECF ($/ac)	NPV ($/ac)
5%	Discount Rate			
	Before Financing	1.4	18.7	287.6
	After Financing	1.1	7.9	121.2
	After Financing & Tax (20%)	1.1	8.4	128.5
	Tax Rate (30%)	1.1	8.6	132.2
3%	Discount Rate			
	Before Financing	1.6	29.8	584.4
	After Financing	1.2	18.1	354.6
	After Financing & Tax (20%)	1.2	16.2	317.7
	Tax Rate (30%)	1.2	15.3	299.2
7%	Discount Rate			
	Before Financing	1.2	8.2	101.3
	After Financing	1.0	-1.1	-13.6
	After Financing & Tax (20%)	1.0	1.7	20.8
	Tax Rate (30%)	1.0	3.1	38.0
10%	Discount Rate			
	Before Financing	0.9	-6.4	-60.5
	After Financing	0.9	-12.2	-115.3
	After Financing & Tax (20%)	1.0	-6.2	-58.8
	Tax Rate (30%)	1.0	-3.2	-30.5
No Residual Value (5%)				
	Before Financing	1.2	11.3	172.9
	After Financing	1.0	0.4	6.5
	After Financing & Tax (20%)	1.0	1.6	25.3
	Tax Rate (30%)	1.0	2.3	34.7
No Residual Value (10%)				
	Before Financing	0.9	-9.4	-88.9
	After Financing	0.9	-15.3	-143.7
	After Financing & Tax (20%)	0.9	-9.0	-84.4
	Tax Rate (30%)	1.0	-5.8	-54.7

1. Scenario 1.

APPENDIX III L

FINANCIAL ANALYSIS: FULL DRAINAGE - BEAVER[1]

Case	B/C Ratio	AECF ($/ac)	NPV ($/ac)
5% Discount Rate			
Before Financing	1.3	16.3	249.8
After Financing	1.0	4.7	72.0
After Financing & Tax (20%)	1.1	5.9	90.9
Tax Rate (30%)	1.1	6.5	100.3
3% Discount Rate			
Before Financing	1.5	27.8	545.3
After Financing	1.2	15.3	300.5
After Financing & Tax (20%)	1.2	14.1	276.2
Tax Rate (30%)	1.1	13.5	264.0
7% Discount Rate			
Before Financing	1.1	5.3	65.6
After Financing	1.0	-4.7	-57.7
After Financing & Tax (20%)	1.0	-1.0	-12.8
Tax Rate (30%)	1.0	0.8	9.6
10% Discount Rate			
Before Financing	0.9	-9.9	-92.9
After Financing	0.9	-16.2	-152.7
After Financing & Tax (20%)	0.9	-9.2	-87.0
Tax Rate (30%)	0.9	-5.7	-54.1
No Residual Value (5%)			
Before Financing	1.2	8.4	129.0
After Financing	1.0	-3.2	-48.8
After Financing & Tax (20%)	1.0	-1.2	-17.9
Tax Rate (30%)	1.0	-0.2	-2.4
No Residual Value (10%)			
Before Financing	0.8	-13.0	-122.9
After Financing	0.8	-19.4	-59.8
After Financing & Tax (20%)	0.9	-12.1	-113.9
Tax Rate (30%)	0.9	-8.4	-79.6

1. Scenario 1.

APPENDIX III M

FINANCIAL ANALYSIS: FULL DRAINAGE - NORTH SASKATCHEWAN[1]

	Case	B/C Ratio	AECF ($/ac)	NPV ($/ac)
5%	Discount Rate			
	Before Financing	1.5	39.8	612.3
	After Financing	1.2	23.5	361.4
	After Financing & Tax (20%)	1.2	21.8	334.6
	Tax Rate (30%)	1.1	20.9	321.2
3%	Discount Rate			
	Before Financing	1.8	55.9	1 095.7
	After Financing	1.3	38.7	757.9
	After Financing & Tax (20%)	1.3	33.4	654.4
	Tax Rate (30%)	1.2	30.8	602.7
7%	Discount Rate			
	Before Financing	1.3	24.2	300.6
	After Financing	1.1	9.9	122.2
	After Financing & Tax (20%)	1.1	11.6	144.3
	Tax Rate (30%)	1.1	12.5	155.4
10%	Discount Rate			
	Before Financing	1.0	1.9	18.2
	After Financing	1.0	-7.7	-72.9
	After Financing & Tax (20%)	1.0	-0.8	-7.7
	Tax Rate (30%)	1.0	2.6	24.8
No Residual Value (5%)				
	Before Financing	1.4	29.4	451.5
	After Financing	1.1	13.1	200.6
	After Financing & Tax (20%)	1.1	12.4	189.9
	Tax Rate (30%)	1.1	12.0	184.6
No Residual Value (10%)				
	Before Financing	1.0	-2.3	-21.6
	After Financing	0.9	-12.0	-112.7
	After Financing & Tax (20%)	1.0	-4.6	-43.6
	Tax Rate (30%)	1.0	-1.0	-9.0

1. Scenario 1.

APPENDIX III N

FINANCIAL ANALYSIS: FULL DRAINAGE - BATTLE

	Case	B/C Ratio	AECF ($/ac)	NPV ($/ac)
5%	Discount Rate			
	Before Financing	1.6	46.4	712.6
	After Financing	1.2	28.3	434.5
	After Financing & Tax (20%)	1.2	25.9	397.6
	Tax Rate (30%)	1.2	24.7	379.2
3%	Discount Rate			
	Before Financing	1.9	64.0	1 254.9
	After Financing	1.3	45.0	882.2
	After Financing & Tax (20%)	1.3	38.7	758.5
	Tax Rate (30%)	1.3	35.5	696.7
7%	Discount Rate			
	Before Financing	1.3	29.1	361.5
	After Financing	1.1	13.1	162.7
	After Financing & Tax (20%)	1.1	14.6	181.5
	Tax Rate (30%)	1.1	15.4	190.9
10%	Discount Rate			
	Before Financing	1.0	4.4	41.2
	After Financing	1.0	-6.5	-61.4
	After Financing & Tax (20%)	1.0	0.7	6.9
	Tax Rate (30%)	1.0	4.4	41.1
No Residual Value (5%)				
	Before Financing	1.4	34.9	536.8
	After Financing	1.1	16.8	258.8
	After Financing & Tax (20%)	1.1	15.6	239.4
	Tax Rate (30%)	1.1	15.0	229.8
No Residual Value (10%)				
	Before Financing	1.0	-0.3	-2.3
	After Financing	0.9	-11.1	-105.0
	After Financing & Tax (20%)	1.0	-3.4	-32.3
	Tax Rate (30%)	1.0	0.4	4.1

1. Scenario 1.

APPENDIX IV A

ECONOMIC ANALYSIS: DEEP PLOWING SOLONETZIC SOILS

Results	NPV	AECF	B/C
	---($/acre)--		(ratio)
1. Black Soil Zone			
a. Base case	315	40.76	4.37
b. 7% discount rate	275	39.19	4.00
c. 20% decrease in prices	233	30.19	3.50
d. Residual value included	396	51.28	5.25
e. 50% increase in plowing costs	268	34.72	2.92
f. Yield response 1	234	30.31	3.51
g. Yield response 2	209	27.02	3.24
h. Yield response 3	126	16.37	2.36
i. Worst case scenario	16	2.21	1.11
2. Dark Brown Soil Zone			
a. Base case	105	13.60	2.13
b. 7% discount rate	87	12.34	1.95
c. 20% decrease in prices	65	8.47	1.70
d. Residual value included	145	18.78	2.56
e. 50% increase in plowing cost	58	7.56	1.42
f. Yield response 1	66	8.52	1.71
g. Yield response 2	53	6.92	1.57
h. Yield response 3	14	1.75	1.14
i. Worst case scenario	-63	-8.98	0.54
3. Brown Soil Zone			
a. Base case	90	11.69	1.97
b. 7% discount rate	73	10.45	1.80
c. 20% decrease in prices	54	6.93	1.57
d. Residual value included	125	16.19	2.34
e. 50% increase in plowing costs	44	5.65	1.57
f. Yield response 1	54	6.99	1.58
g. Yield response 2	43	5.51	1.46
h. Yield response 3	6	0.72	1.06
i. Worst case scenario	-23	-3.25	0.75

APPENDIX IV B

FINANCIAL ANALYSIS[1]: DEEP PLOWING
SOLONETZIC SOILS - WITH A RESIDUAL VALUE

Case	NPV ($ /acre)			AECF ($ /acre)			B/C (ratio)		
	Total Resources	After Fin.	After Fin&Tax	Total Resources	After Fin	After Fin&Tax	Total Resources	After Fin.	After Fin&Tax
Black									
Base Case (5%)	372.99	356.57	295.52	48.30	46.18	38.27	5.00	2.53	2.01
Discount rate 3%	431.34	403.84	333.16	50.57	47.34	39.06	5.53	2.62	2.04
Discount rate 7%	323.57	316.44	263.58	46.07	45.05	37.53	4.53	2.45	1.97
Discount rate 10%	262.82	266.94	224.20	42.77	43.44	36.49	3.95	2.33	1.92
Tax rate 30%	-	-	265.00	-	-	34.32	-	-	1.82
Dark Brown									
Base Case (5%)	163.14	146.72	127.64	21.13	19.00	16.53	2.75	1.63	1.51
Discount rate 3%	197.00	169.50	145.68	23.09	19.87	17.08	3.07	1.68	1.54
Discount rate 7%	134.81	127.68	112.57	19.19	18.18	16.03	2.47	1.58	1.48
Discount rate 10%	100.52	104.64	94.36	16.36	17.03	15.36	2.13	1.52	1.45
Tax Rate 30%	-	-	118.10	-	-	15.29	-	-	1.45
Brown									
Base Case (5%)	149.60	133.18	116.81	19.37	17.25	15.13	2.60	1.57	1.47
Discount rate 3%	181.88	154.38	133.59	21.32	18.10	15.66	2.91	1.62	1.49
Discount rate 7%	122.63	115.50	102.83	17.46	16.44	14.64	2.34	1.53	1.44
Discount rate 10%	90.05	94.17	85.98	14.66	15.33	13.99	2.01	1.47	1.41
Tax Rate 30%	-	-	108.62	-	-	14.07	-	-	1.42

1. Based on a 10-year project.

APPENDIX IV C

FINANCIAL ANALYSIS[1]: DEEP PLOWING
SOLONETZIC SOILS - NO RESIDUAL VALUE

Case	NPV			AECF			B/C		
	Total Resources	After Fin.	After Fin&Tax	Total Resources	After Fin	After Fin&Tax	Total Resources	After Fin.	After Fin&Tax
	($ /acre)			($ /acre)			(ratio)		
Black									
Base Case (5%)	312.83	296.40	241.37	40.51	38.39	31.26	4.35	2.27	1.84
Discount rate 3%	358.41	330.92	267.53	42.02	38.79	31.36	4.77	2.33	1.86
Discount rate 7%	273.75	266.62	218.74	38.98	37.96	31.14	3.99	2.22	1.82
Discount rate 10%	225.04	229.16	190.20	36.62	37.29	30.95	3.53	2.15	1.80
Tax rate 30%	-	-	213.86	-	-	27.20	-	-	1.68
Dark Brown									
Base Case (5%)	102.98	86.55	73.49	13.34	11.21	9.52	2.10	1.37	1.30
Discount rate 3%	124.07	96.58	80.06	14.55	11.32	9.38	2.30	1.39	1.30
Discount rate 7%	84.99	77.86	67.74	12.10	11.09	9.64	1.93	1.36	1.30
Discount rate 10	62.74	66.86	60.36	10.21	10.88	9.82	1.70	1.33	1.29
Tax Rate 30%	-	-	66.96	-	-	8.67	-	-	1.27
Brown									
Base Case (5%)	89.44	73.02	62.66	11.58	9.46	8.11	1.96	1.31	1.26
Discount rate 3%	108.96	81.46	67.96	12.77	9.55	7.97	2.15	1.33	1.26
Discount rate 7%	72.81	65.68	57.99	10.37	9.35	8.26	1.80	1.30	1.26
Discount rate 10%	52.27	56.39	51.98	8.51	9.18	8.46	1.59	1.28	1.25
Tax Rate 30%	-	-	57.48	-	-	7.44	-	-	1.23

1. Based on a 10-year project.

APPENDIX V A

ECONOMIC ANALYSIS: LIMING ACID SOILS

	NPV	AECF	B/C	IRR
	------($/acre)-----			(%)
1. Gray				
a. Discount rate at 3%	46.71	5.48	1.85	18
b. Discount rate at 7%	28.25	4.02	1.54	18
c. Residual land value included	62.57	8.10	2.17	21
d. Fertilizer application increase 10%	31.01	4.02	1.70	18
e. Fertilizer application increase 20%	25.27	3.27	1.40	14
f. Yield or price decrease 10%	27.73	3.59	1.50	15
g. Yield or price decrease 20%	18.71	2.42	1.30	12
h. Liming costs increase 10%	32.67	4.23	1.60	16
i. Liming costs increase 20%	28.59	3.70	1.60	14
2. Dark Brown				
a. Discount rate at 3%	60.83	7.13	2.11	22
b. Discount rate at 7%	39.64	5.64	1.76	22
c. Residual land value included	78.00	10.10	2.40	25
d. Fertilizer application increase 10%	44.85	5.81	1.80	21
e. Fertilizer application increase 20%	40.29	5.22	1.60	19
f. Yield or price decrease 10%	39.10	5.06	1.70	19
g. Yield or price decrease 20%	28.85	3.74	1.50	15
h. Liming costs increase 10%	45.78	5.93	1.80	20
i. Liming costs increase 20%	42.16	5.46	1.70	18
3. Black				
a. Discount rate at 3%	65.66	7.70	2.19	23
b. Discount rate at 7%	43.23	6.15	1.82	23
c. Residual land value included	83.20	10.77	2.55	26
d. Fertilizer application increase 10%	47.39	6.14	1.79	21
e. Fertilizer application increase 20%	41.22	5.34	1.62	19
f. Yield or price decrease 10%	42.84	5.55	1.80	20
g. Yield or price decrease 20%	32.13	4.16	1.60	16
h. Liming costs increase 10%	48.20	6.24	1.82	20
i. Liming costs increase 20%	42.84	5.55	1.67	18

APPENDIX V B

FINANCIAL ANALYSIS: LIMING ACID SOILS [1]
WITH A RESIDUAL VALUE

Case	NPV ($ /acre)			AECF ($ /acre)			B/C (ratio)		
	Total Resources	After Fin.	After Fin&Tax	Total Resources	After Fin	After Fin&Tax	Total Resources	After Fin.	After Fin&Tax
Gray									
Base Case (5%)	94.18	73.34	64.70	12.20	9.50	8.38	2.76	1.55	1.46
Discount rate 3%	112.20	84.31	73.41	13.15	9.88	8.61	3.04	1.59	1.48
Discount rate 7%	79.17	64.26	57.50	11.27	9.15	8.19	2.51	1.52	1.44
Discount rate 10%	61.08	53.41	48.87	9.94	8.69	7.95	2.21	1.47	1.41
Tax rate 30%	-	-	60.39	-	-	7.82	-	-	1.41
Dark Brown									
Base Case (5%)	106.26	82.73	72.10	13.76	10.71	9.34	2.99	1.62	1.50
Discount rate 3%	125.72	94.90	81.76	14.74	11.13	9.58	3.29	1.66	1.52
Discount rate 7%	90.01	72.62	64.07	12.82	10.34	9.12	2.73	1.58	1.48
Discount rate 10%	70.38	60.47	54.42	11.45	9.84	8.86	2.40	1.54	1.46
Tax Rate 30%	-	-	66.78	-	-	8.65	-	-	1.46
Black (Central)									
Base Case (5%)	107.29	86.46	75.20	13.89	11.20	9.74	3.00	1.65	1.52
Discount rate 3%	126.97	99.10	85.25	14.89	11.62	9.99	3.31	1.69	1.54
Discount rate 7%	90.84	75.95	66.85	12.93	10.81	9.52	2.73	1.61	1.50
Discount rate 10%	70.98	63.32	56.80	11.55	10.30	9.24	2.40	1.56	1.47
Tax Rate 30%	-	-	69.57	-	-	9.01	-	-	1.46

1. Based on a 10-year project.

APPENDIX V C

FINANCIAL ANALYSIS: LIMING ACID SOILS [1]
NO RESIDUAL VALUE

Case	NPV			AECF			B/C		
	Total Resources	After Fin.	After Fin&Tax	Total Resources	After Fin	After Fin&Tax	Total Resources	After Fin.	After Fin&Tax
	($ /acre)			($ /acre)			(ratio)		
Gray									
Base Case (5%)	59.19	38.35	33.21	7.67	4.97	4.30	2.10	1.29	1.24
Discount rate 3%	69.78	41.90	35.24	8.18	4.91	4.13	2.27	1.29	1.24
Discount rate 7%	50.19	35.29	31.42	7.15	5.02	4.47	1.96	1.28	1.24
Discount rate 10%	39.10	31.43	29.10	6.36	5.12	4.74	1.77	1.28	1.25
Tax rate 30%	-	-	30.64	-	-	3.97	-	-	1.22
Dark Brown									
Base Case (5%)	71.27	47.74	40.61	9.23	6.18	5.26	2.33	1.36	1.27
Discount rate 3%	83.31	52.49	43.59	9.77	6.15	5.11	2.52	1.37	1.29
Discount rate 7%	61.03	43.64	38.00	8.69	6.21	5.41	2.17	1.35	1.29
Discount rate 10%	48.41	38.49	34.64	7.88	6.26	5.64	1.96	1.34	1.30
Tax Rate 30%	-	-	37.04	-	-	3.97	-	-	1.24
Black (Central)									
Base Case (5%)	72.30	51.47	43.71	9.36	6.67	5.66	2.35	1.39	1.31
Discount rate 3%	84.56	56.69	47.08	9.91	6.65	5.52	2.54	1.40	1.31
Discount rate 7%	61.87	46.98	40.77	8.81	6.69	5.80	2.18	1.38	1.31
Discount rate 10%	49.01	41.34	37.03	7.98	6.73	6.03	1.97	1.36	1.31
Tax Rate 30%	-	-	39.83	-	-	5.16	-	-	1.28

1. Based on a 10-year project.

APPENDIX VI A

ECONOMIC ANALYSIS: SUMMERFALLOW REDUCTION

	B/C (ratio)	AECF ($/acre)
1. Brown (1/2 - 1/2 to 1/3 - 2/3)		
a. Base scenario	0.80	-2.08
b. 20% decrease in yields	0.24	-8.11
c. 20% decrease in prices	0.64	-3.78
d. 10-year yield series	0.77	-2.47
e. 10-year yield series 20% decrease in prices	0.61	-4.10
f. Machine replacement policy 0.5	0.80	-2.16
2. Dark Brown (1/3 -2/3 to C/C)		
a. Base scenario	1.31	9.07
b. 20% decrease in yields	0.65	-10.22
c. 20% decrease in prices	1.05	1.44
d. 10-year yield series	1.18	5.24
e. 10-year yield series 20% decrease in prices	0.94	1.64
f. Machine replacement policy 0.5	1.25	7.64
3. Black - North-East (1/4 - 3/4 to C/C)		
a. Base scenario	1.25	4.54
b. 20% decrease in yields	0.47	-9.41
c. 20% decrease in prices	1.00	0.07
d. 10-year yield series	1.16	2.92
e. 10-year yield series 20% decrease in prices	0.93	-1.23
f. Machine replacement policy 0.5	0.85	-3.96
4. Black - Central (1/4 - 3/4 to C/C)		
a. Base scenerio	1.60	10.66
b. 20% decrease in yields	0.73	-4.85
c. 20% decrease in prices	1.28	4.96
d. 10-year yield series	1.55	9.89
e. 10-year yield series 20% decrease in prices	1.24	3.92
f. Machine replacement policy 0.5	1.08	2.16
5. Gray (1/4 - 3/4 to C/C)		
a. Base scenario	1.20	3.22
b. 20% decrease in yields	0.51	-7.81
c. 20% decrease in prices	0.96	-0.61
d. 10-year yield series	1.22	3.52
e. 10-year yield series 20% decrease in prices	0.98	-0.37
f. Machine replacement policy 0.5	0.86	-3.21

APPENDIX VI B

FINANCIAL ANALYSIS: SUMMERFALLOW REDUCTION[1]
BROWN SOIL ZONE

Case	NPV ($ /acre)			ACEF ($ /acre)			B/C (ratio)		
	Total Resources	After Fin.	After Fin&Tax	Total Resources	After Fin	After Fin&Tax	Total Resources	After Fin.	After Fin&Tax
1. 1/2-1/2 to 1/3-2/3									
Base Case (5%)	-10.50	-12.00	-9.59	-1.48	-1.69	-1.35	0.87	0.86	0.88
Discount rate 3%	-11.33	-13.24	-10.59	-1.46	-1.70	-1.36	0.87	0.86	0.88
Discount rate 7%	-9.76	-10.91	-8.72	-1.50	-1.67	-1.34	0.87	0.86	0.88
Discount rate 10%	-8.81	-9.53	-7.61	-1.53	-1.65	-1.32	0.86	0.86	0.88
Tax rate 30%	-	-	-8.39	-	-	-1.18	-	-	0.90
2. 1/2-1/2 to 1/4-3/4									
Base Case (5%)	-47.89	-49.89	-44.04	-6.74	-7.02	-6.20	0.68	0.68	0.71
Discount rate 3%	-56.95	-59.49	-53.11	-7.31	-7.64	-6.82	0.66	0.66	0.69
Discount rate 7%	-40.89	-42.42	-37.05	-6.28	-6.51	-5.69	0.70	0.70	0.73
Discount rate 10%	-33.13	-34.09	-29.32	-5.75	-5.92	-5.09	0.71	0.72	0.75
Tax Rate 30%	-	-	-41.12	-	-	-5.79	-	-	0.72
3. 1/3-2/3 to 1/4-3/4									
Base Case (5%)	-37.39	-37.89	-34.45	-5.26	-5.33	-4.85	0.48	0.48	0.50
Discount rate 3%	-45.61	-46.24	-42.52	-5.86	-5.94	-5.46	0.45	0.45	0.47
Discount rate 7%	-31.13	-31.51	-28.33	-4.78	-4.84	-4.35	0.50	0.50	0.53
Discount rate 10%	-24.31	-24.55	-21.70	-4.22	-4.26	-3.77	0.53	0.54	0.57
Tax Rate 30%	-	-	-32.73	-	-	-4.60	-	-	0.52

1. Based on a 9-year project.

APPENDIX VI C

FINANCIAL ANALYSIS: SUMMERFALLOW REDUCTION[1]
DARK BROWN SOIL ZONE

Case	NPV ($ /acre)			AECF ($ /acre)			B/C (ratio)		
	Total Resources	After Fin.	After Fin&Tax	Total Resources	After Fin	After Fin&Tax	Total Resources	After Fin.	After Fin&Tax
1. 1/3-2/3 to C/C									
Base Case (5%)	76.57	73.21	58.58	10.77	10.30	8.24	1.36	1.32	1.24
Discount rate 3%	84.15	79.87	63.90	10.81	10.26	8.21	1.36	1.32	1.24
Discount rate 7%	69.96	67.38	53.92	10.74	10.34	8.28	1.35	1.32	1.24
Discount rate 10%	61.55	59.91	47.95	10.69	10.40	8.33	1.35	1.33	1.25
Tax rate 30%	-	-	51.27	-	-	7.21	-	-	1.20
2. 1/4-3/4 to C/C									
Base Case (5%)	70.56	67.38	53.92	9.93	9.48	7.59	1.48	1.43	1.32
Discount rate 3%	77.64	73.56	58.85	9.97	9.45	7.56	1.48	1.43	1.32
Discount rate 7%	64.39	61.97	49.59	9.88	9.51	7.61	1.48	1.43	1.32
Discount rate 10%	56.55	55.05	44.06	9.82	9.56	7.65	1.48	1.43	1.32
Tax Rate 30%	-	-	47.19	-	-	6.64	-	-	1.27
3. 1/3-2/3 to 1/4-3/4									
Base Case (5%)	5.89	5.62	4.50	0.83	0.79	0.63	1.09	1.08	1.06
Discount rate 3%	6.39	6.07	4.86	0.82	0.78	0.62	1.08	1.08	1.06
Discount rate 7%	5.45	5.23	4.18	0.84	0.80	0.64	1.09	1.08	1.06
Discount rate 10%	4.90	4.72	3.78	0.85	0.82	0.66	1.09	1.08	1.07
Tax Rate 30%	-	-	3.93	-	-	0.55	-	-	1.05

1. Based on a 9-year project.

APPENDIX VI D

FINANCIAL ANALYSIS: SUMMERFALLOW REDUCTION[1]
BLACK (NORTHEAST) SOIL ZONE

Case	NPV			AECF			B/C		
	Total Resources	After Fin.	After Fin&Tax	Total Resources	After Fin	After Fin&Tax	Total Resources	After Fin.	After Fin&Tax
	($ /acre)			($ /acre)			(ratio)		
1. 1/3-2/3 to C/C									
Base Case (5%)	60.05	60.05	48.04	8.45	8.45	6.76	1.32	1.32	1.24
Discount rate 3%	65.54	65.54	52.43	8.42	8.42	6.73	1.32	1.32	1.24
Discount rate 7%	55.23	55.23	44.19	8.48	8.48	6.78	1.32	1.32	1.24
Discount rate 10%	49.08	49.08	39.26	8.52	8.52	6.82	1.33	1.33	1.24
Tax rate 30%	-	-	42.03	-	-	5.91	-	-	1.21
2. 1/4-3/4 to C/C									
Base Case (5%)	38.80	38.80	31.04	5.46	5.46	4.37	1.29	1.29	1.22
Discount rate 3%	42.30	42.30	33.84	5.43	5.43	4.35	1.29	1.29	1.22
Discount rate 7%	35.73	35.73	28.58	5.48	5.48	4.39	1.29	1.29	1.22
Discount rate 10%	31.79	31.79	25.43	5.52	5.52	4.42	1.29	1.29	1.22
Tax Rate 30%	-	-	27.16	-	-	3.82	-	-	1.19
3. 1/3-2/3 to 1/4-3/4									
Base Case (5%)	21.15	21.15	17.00	2.99	2.99	2.39	1.40	1.40	1.30
Discount rate 3%	23.24	23.24	18.59	2.98	2.98	2.39	1.40	1.40	1.30
Discount rate 7%	19.51	19.51	15.61	2.99	2.99	2.40	1.40	1.40	1.30
Discount rate 10%	17.28	17.28	13.83	3.00	3.00	2.40	1.40	1.40	1.30
Tax Rate 30%	-	-	14.87	-	-	2.09	-	-	1.25

1. Based on a 9-year project.

APPENDIX VI E

FINANCIAL ANALYSIS: SUMMERFALLOW REDUCTION[1]
BLACK (CENTRAL) SOIL ZONE

Case	NPV ($ /acre)			AECF ($ /acre)			B/C (ratio)		
	Total Resources	After Fin.	After Fin&Tax	Total Resources	After Fin	After Fin&Tax	Total Resources	After Fin.	After Fin&Tax
1. 1/3-2/3 to C/C									
Base Case (5%)	89.78	89.78	71.82	12.63	12.63	10.10	1.48	1.48	1.35
Discount rate 3%	98.23	98.23	78.59	12.62	12.62	10.09	1.48	1.48	1.35
Discount rate 7%	82.38	82.38	65.91	12.64	12.64	10.12	1.48	1.48	1.35
Discount rate 10%	72.94	72.94	58.35	12.67	12.67	10.13	1.48	1.48	1.35
Tax rate 30%	-	-	62.84	-	-	8.84	-	-	1.29
2. 1/4-3/4 to C/C									
Base Case (5%)	82.82	82.82	66.25	11.65	11.65	9.32	1.62	1.62	1.44
Discount rate 3%	90.55	90.55	72.44	11.63	11.63	9.30	1.62	1.62	1.44
Discount rate 7%	76.05	76.05	60.84	11.67	11.67	9.34	1.62	1.62	1.44
Discount rate 10%	67.39	67.39	53.92	11.70	11.70	9.36	1.62	1.62	1.44
Tax Rate 30%	-	-	57.97	-	-	8.16	-	-	1.36
3. 1/3-2/3 to 1/4-3/4									
Base Case (5%)	6.96	6.96	5.57	0.98	0.98	0.78	1.13	1.13	1.10
Discount rate 3%	7.68	7.68	6.15	0.99	0.99	0.79	1.13	1.13	1.10
Discount rate 7%	6.33	6.33	5.07	0.97	0.97	0.78	1.13	1.13	1.10
Discount rate 10%	5.54	5.54	4.44	0.96	0.96	0.77	1.13	1.13	1.10
Tax Rate 30%	-	-	4.87	-	-	0.69	-	-	1.09

1. Based on a 9-year project.

APPENDIX VI F

FINANCIAL ANALYSIS: SUMMERFALLOW REDUCTION[1]
GRAY SOIL ZONE

Case	NPV ($ /acre)			AECF ($ /acre)			B/C (ratio)		
	Total Resources	After Fin.	After Fin&Tax	Total Resources	After Fin	After Fin&Tax	Total Resources	After Fin.	After Fin&Tax
1. 1/3-2/3 to C/C									
Base Case (5%)	39.63	39.63	31.70	5.58	5.58	4.46	1.23	1.23	1.17
Discount rate 3%	43.08	43.08	34.46	5.53	5.53	4.43	1.23	1.23	1.18
Discount rate 7%	36.60	36.60	29.28	5.62	5.62	4.49	1.23	1.23	1.18
Discount rate 10%	32.69	32.69	26.15	5.68	5.68	4.54	1.24	1.24	1.18
Tax rate 30%	-	-	27.74	-	-	3.90	-	-	1.25
2. 1/4-3/4 to C/C									
Base Case (5%)	30.19	30.19	24.15	4.25	4.25	3.40	1.25	1.25	1.19
Discount rate 3%	32.87	32.87	26.30	4.22	4.22	3.38	1.25	1.25	1.19
Discount rate 7%	27.84	27.84	22.27	4.27	4.27	3.42	1.25	1.25	1.19
Discount rate 10%	24.81	24.81	19.85	4.31	4.31	3.45	1.25	1.25	1.19
Tax Rate 30%	-	-	21.13	-	-	2.97	-	-	1.08
3. 1/3-2/3 to 1/4-3/4									
Base Case (5%)	9.44	9.44	7.55	1.33	1.33	1.06	1.19	1.19	1.14
Discount rate 3%	10.20	10.20	8.16	1.31	1.31	1.05	1.19	1.19	1.14
Discount rate 7%	8.76	8.76	7.01	1.34	1.34	1.08	1.19	1.19	1.15
Discount rate 10%	7.88	7.88	6.30	1.37	1.37	1.09	1.19	1.19	1.15
Tax Rate 30%	-	-	6.61	-	-	0.93	-	-	1.13

1. Based on a 9-year project.

APPENDIX VII A

ECONOMIC ANALYSIS: RANGE IMPROVEMENT

I. Reseeding Prairie Range	NPV ---($/acre)---	AECF	B/C (ratio)	IRR[4] (%)
Brown soils				
a. Base case[1]	3.60	0.29	1.01	6
b. 3% discount rate	18.00	1.21	1.05	6
c. 7% discount rate	(7.40)	(0.69)	0.97	6
d. 10% increase in revenue	33.70	2.71	1.11	10
e. 20% increase in revenue	63.90	5.13	1.21	14
f. 10% decrease in revenue	(26.60)	(2.13)	0.91	0
g. 20% decrease in revenue	(56.80)	(4.55)	0.81	0
h. 10% increase in capital costs	(3.00)	(0.24)	0.99	0
i. 20% increase in capital costs	(9.50)	(0.77)	0.97	4
j. 10% decrease in capital costs	10.10	0.81	1.03	7
k. 20% decrease in capital costs	16.70	1.34	1.06	8
l. 10% increase in total costs	(26.20)	(2.11)	0.92	0
m. 20% increase in total costs	(56.00)	(4.50)	0.84	0
n. 10% decrease in total costs	33.40	2.68	1.12	11
o. 20% decrease in total costs	63.20	5.07	1.26	16
p. Break, reseed after 9 years	(47.40)	(3.81)	0.86	0
q. Worse case[2]	(76.00)	(6.10)	0.77	0
r. Residual value of land included	29.50	2.36	1.10	8
s. AUM's increased[3]	116.27	9.33	1.18	21

1. Base case (Brown): 5 per cent discount rate, no fencing or fertilizer costs and 0.2 AUM increase in carrying capacity.

2. Break and reseed after 9 years and 10 per cent decrease in revenue.

3. Increase in carrying capacity at 0.5 AUM/acre.

4. IRR of "0" indicates some negative value.

APPENDIX VII A (continued)

ECONOMIC ANALYSIS: RANGE IMPROVEMENT

I. Reseeding Prairie Range	NPV	AECF	B/C	IRR[4]
	---($/acre)---		(ratio)	(%)
Dark Brown soils				
a. Base case[1]	188.97	15.16	1.22	28
b. 3% discount rate	243.10	16.34	1.24	28
c. 7% discount rate	147.46	13.92	1.20	28
d. 10% increase in revenue	294.53	23.63	1.34	39
e. 20% increase in revenue	400.09	32.10	1.46	50
f. 10% decrease in revenue	83.41	6.69	1.10	16
g. 20% decrease in revenue	(22.16)	(1.78)	0.97	1
h. 10% increase in capital costs	182.42	14.64	1.21	26
i. 20% increase in capital costs	175.87	14.11	1.20	24
j. 10% decrease in capital costs	195.52	15.69	1.23	31
k. 20% decrease in capital costs	202.06	16.21	1.24	34
l. 10% increase in total costs	102.30	8.21	1.11	17
m. 20% increase in total costs	15.64	1.25	1.02	7
n. 10% decrease in total costs	275.63	22.12	1.35	41
o. 20% decrease in total costs	362.30	29.07	1.52	50
p. Break, reseed after 9 years	124.24	9.97	1.14	23
q. Worse case[2]	24.31	1.95	1.03	9
r. Fencing costs included	160.27	12.86	1.18	20
s. Residual value of land included	214.88	17.24	1.25	28
t. AUM's increased[3]	225.32	18.08	1.23	31

1. Base case (Dark Brown): 5 per cent discount rate, no fencing or fertilizer costs and 0.7 AUM increase in carrying capacity.

2. Break and reseed after 9 years and 10 per cent decrease in revenue.

3. Increase in carrying capacity at 0.8 AUM/acre.

4. IRR of "50" indicates a value greater than 50.

APPENDIX VII A (continued)

ECONOMIC ANALYSIS: RANGE IMPROVEMENT

I. Reseeding Prairie Range	NPV ---($/acre)---	AECF	B/C (ratio)	IRR[4] (%)
Black soils				
a. Base case[1]	298.02	23.91	1.25	38
b. 3% discount rate	375.89	25.27	1.26	38
c. 7% discount rate	238.20	22.48	1.23	38
d. 10% increase in revenue	448.82	36.01	1.37	50
e. 20% increase in revenue	599.62	48.12	1.50	68
f. 10% decrease in revenue	147.21	11.81	1.12	22
g. 20% decrease in revenue	(3.59)	(0.29)	1.00	5
h. 10% increase in capital costs	291.47	23.39	1.24	35
i. 20% increase in capital costs	284.92	22.86	1.23	33
j. 10% decrease in capital costs	304.56	24.44	1.25	41
k. 20% decrease in capital costs	311.11	24.96	1.26	45
l. 10% increase in total costs	177.01	14.20	1.13	24
m. 20% increase in total costs	56.01	4.49	1.04	11
n. 10% decrease in total costs	419.02	33.62	1.38	50
o. 20% decrease in total costs	540.02	43.33	1.56	50
p. Break, reseed after 9 years	223.64	17.95	1.19	34
q. Worse case[2]	80.88	6.49	1.07	16
r. Residual value of land included	323.93	25.99	1.27	38
s. AUM's increased[3]	443.41	35.58	1.27	49

1. Base case (Black): 5 per cent discount rate, no fencing or fertilizer costs and 1.0 AUM increase in carrying capacity.

2. Break and reseed after 9 years and 10 per cent decrease in revenue.

3. Increase in carrying capacity at 1.4 AUM/acre.

4. IRR of "50" indicates a value greater than 50.

APPENDIX VII A (continued)

ECONOMIC ANALYSIS: RANGE IMPROVEMENT

II. Conversion of Woodland to Pasture	NPV	AECF	B/C	IRR[5]
	---($/acre)---		(ratio)	(%)
Black soils				
a. Base case[1]	(107.80)	(8.65)	0.95	.3
b. 3% discount rate	(72.20)	(4.85)	0.97	.3
c. 7% discount rate	(133.00)	(12.56)	0.93	.3
d. 10% increase in revenue	115.50	9.27	1.05	9
e. 20% increase in revenue	338.90	27.19	1.14	15
f. 10% decrease in revenue	(331.10)	(26.56)	0.86	0
g. 20% decrease in revenue	(554.40)	(44.48)	0.76	0
h. 10% increase in capital costs	(135.60)	(10.88)	0.94	0
i. 20% increase in capital costs	(163.50)	(13.12)	0.93	0
j. 10% decrease in capital costs	(79.90)	(6.41)	0.97	1
k. 20% decrease in capital costs	(52.00)	(4.17)	0.98	2
l. 10% increase in total costs	(341.80)	(27.43)	0.87	0
m. 20% increase in total costs	(575.90)	(46.21)	0.79	0
n. 10% decrease in total costs	126.30	10.14	1.06	9
o. 20% decrease in total costs	360.40	28.92	1.19	18
p. Break, reseed after 9 years	(183.70)	(14.74)	0.92	0
q. Worse case[2]	(394.30)	(31.64)	0.83	0
r. Residual value of land included	7.40	0.59	1.00	5
s. No fertilizer, AUM's reduced[3]	131.60	10.56	1.09	10
t. AUM's increased[4]	544.10	43.66	1.15	20

1. Base case (Black): 5 per cent discount rate, fencing and fertilizer costs and 1.75 AUM increase in carrying capacity.

2. Break and reseed after 9 years and 10 per cent decrease in revenue.

3. Increase in carrying capacity at 1.25 AUM's/acre with no fertilizer.

4. Increase in carrying capacity at 3.25 AUM/acre.

5. IRR of "0" indicates some negative value.

APPENDIX VII A (continued)

ECONOMIC ANALYSIS: RANGE IMPROVEMENT

II. Conversion of Woodland to Pasture	NPV ---($/acre)---	AECF	B/C (ratio)	IRR[4] (%)
Gray soils				
a. Base case[1]	(86.40)	(6.93)	0.96	1
b. 3% discount rate	(46.80)	(3.14)	0.98	1
c. 7% discount rate	(114.80)	(10.83)	0.94	1
d. 10% increase in revenue	143.30	11.50	1.06	10
e. 20% increase in revenue	373.00	29.93	1.16	16
f. 10% decrease in revenue	(316.00)	(25.36)	0.87	0
g. 20% decrease in revenue	(545.70)	(43.79)	0.77	0
h. 10% increase in capital costs	(114.20)	(9.17)	0.95	.4
i. 20% increase in capital costs	(142.10)	(11.40)	0.94	0
j. 10% decrease in capital costs	(58.50)	(4.69)	0.98	2
k. 20% decrease in capital costs	(30.60)	(2.46)	0.99	4
l. 10% increase in total costs	(324.70)	(26.05)	0.88	0
m. 20% increase in total costs	(563.00)	(45.18)	0.80	0
n. 10% decrease in total costs	152.00	12.19	1.07	11
o. 20% decrease in total costs	390.30	31.32	1.20	19
p. Break, reseed after 9 years	(162.20)	(13.01)	0.93	0
q. Worse case[2]	(378.70)	(30.39)	0.84	0
r. Residual value of land included	28.80	2.31	1.01	6
s. AUM's increased[3]	565.51	45.38	1.16	21

1. Base case (Gray): 5 per cent discount rate, fencing and fertilizer costs and 1.80 AUM increase in carrying capacity.

2. Break and reseed after 9 years and 10 per cent decrease in revenue.

3. Increase in carrying capacity at 3.30 AUM/acre.

4. IRR of "0" indicates some negative value.

APPENDIX VII B

FINANCIAL ANALYSIS: PRAIRIE RANGE IMPROVEMENT[1]
WITH RESIDUAL VALUE

Case	NPV ($ /acre)			AECF ($ /acre)			B/C (ratio)		
	Total Resources	After Fin.	After Fin&Tax	Total Resources	After Fin	After Fin&Tax	Total Resources	After Fin.	After Fin&Tax
Brown									
Base Case (5%)	29.45	6.53	10.79	2.36	0.52	0.87	1.10	1.01	1.02
Discount rate 3%	56.10	23.11	24.26	3.77	1.55	1.63	1.16	1.03	1.03
Discount rate 7%	10.40	-4.24	2.20	0.98	-0.40	0.21	1.04	0.99	1.00
Discount rate 10%	-8.83	-13.61	-5.05	-1.04	-1.60	-0.59	0.96	0.97	0.99
Tax Rate 30%	-	-	12.93	-	-	1.04	-	-	1.02
Dark Brown									
Base Case (5%)	214.94	165.09	137.64	17.25	13.25	11.04	1.25	1.10	1.08
Discount rate 3%	281.25	215.73	178.36	18.90	14.50	11.99	1.27	1.10	1.08
Discount rate 7%	165.29	128.04	108.03	15.60	12.09	10.20	1.22	1.09	1.07
Discount rate 10%	112.11	89.54	77.47	13.17	10.52	9.10	1.19	1.08	1.07
Tax Rate 30%	-	-	123.92	-	-	9.94	-	-	1.07
Black									
Base Case (5%)	323.86	257.84	211.85	25.99	20.69	17.00	1.27	1.11	1.09
Discount rate 3%	413.89	328.84	268.84	27.82	22.10	18.07	1.29	1.11	1.09
Discount rate 7%	255.91	205.11	169.68	24.16	19.36	16.02	1.25	1.10	1.08
Discount rate 10%	182.45	149.20	125.20	21.43	17.52	14.71	1.22	1.09	1.08
Tax rate 30%	-	-	188.55	-	-	15.15	-	-	1.08

1. Based on a 20-year project.

APPENDIX VII C

FINANCIAL ANALYSIS: PRAIRIE RANGE IMPROVEMENT[1]
NO RESIDUAL VALUE

Case	NPV ($ /acre)			AECF ($ /acre)			B/C (ratio)		
	Total Resources	After Fin.	After Fin&Tax	Total Resources	After Fin	After Fin&Tax	Total Resources	After Fin.	After Fin&Tax
Brown									
Base Case (5%)	3.54	-19.39	-12.53	0.28	-1.56	-1.00	1.01	0.97	0.98
Discount rate 3%	18.03	-14.95	-10.00	1.21	-1.00	-0.67	1.05	0.98	0.99
Discount rate 7%	-7.37	-22.02	-13.79	-0.70	-2.08	-1.30	0.97	0.96	0.97
Discount rate 10%	-19.05	-23.83	-14.25	-2.24	-2.80	-1.67	0.91	0.95	0.97
Tax Rate 30%	-	-	-9.10	-	-	-0.73	-	-	0.98
Dark Brown									
Base Case (5%)	189.04	139.18	114.32	15.17	11.17	9.17	1.22	1.08	1.07
Discount rate 3%	243.19	177.66	144.09	16.35	11.94	9.69	1.24	1.09	1.07
Discount rate 7%	147.41	110.27	92.04	13.92	10.41	8.69	1.20	1.08	1.06
Discount rate 10%	101.89	79.31	68.27	11.97	9.32	8.02	1.17	1.07	1.06
Tax Rate 30%	-	-	101.89	-	-	8.18	-	-	1.06
Black									
Base Case (5%)	297.95	231.93	188.53	23.91	18.61	15.13	1.25	1.10	1.08
Discount rate 3%	375.82	290.78	234.58	25.26	19.54	15.77	1.26	1.10	1.08
Discount rate 7%	238.15	187.34	153.69	22.48	17.68	14.51	1.23	1.09	1.07
Discount rate 10%	172.23	138.98	116.00	20.23	16.32	13.63	1.21	1.09	1.07
Tax rate 30%	-	-	166.82	-	-	13.39	-	-	1.07

1. Based on a 20-year project.

APPENDIX VII D

FINANCIAL ANALYSIS: WOODLAND RANGE IMPROVEMENT[1]
WITH RESIDUAL VALUE

Case	NPV ($ /acre)			AECF ($ /acre)			B/C (ratio)		
	Total Resources	After Fin.	After Fin&Tax	Total Resources	After Fin	After Fin&Tax	Total Resources	After Fin.	After Fin&Tax
Black									
Base Case (5%)	7.29	-152.43	-97.75	0.58	-12.23	-7.84	1.00	0.97	0.98
Discount rate 3%	96.82	-118.48	-69.39	6.51	-7.96	-4.66	1.03	0.98	0.99
Discount rate 7%	-54.16	-169.31	-111.54	-5.11	-15.98	-10.53	0.97	0.95	0.97
Discount rate 10%	-112.35	-176.14	-116.65	-13.20	-20.69	-13.70	0.93	0.94	0.96
Tax Rate 30%	-	-	-70.40	-	-	-5.65	-	-	0.98
Gray									
Base Case (5%)	28.62	-133.38	-82.51	2.30	-10.70	-6.62	1.01	0.97	0.98
Discount rate 3%	122.17	-95.94	-51.36	8.21	-6.45	-3.45	1.04	0.98	0.99
Discount rate 7%	-35.95	-152.96	-98.46	-3.39	-14.44	-9.29	0.98	0.96	0.97
Discount rate 10%	-97.61	-162.81	-105.99	-11.47	-19.12	-12.45	0.94	0.94	0.96
Tax rate 30%	-	-	-57.07	-	-	-4.58	-	-	0.99

1. Based on a 20-year project.

APPENDIX VII E

FINANCIAL ANALYSIS: WOODLAND RANGE IMPROVEMENT[1]
NO RESIDUAL VALUE

Case	NPV			AECF			B/C		
	Total Resources	After Fin.	After Fin&Tax	Total Resources	After Fin	After Fin&Tax	Total Resources	After Fin.	After Fin&Tax
	($ /acre)			($ /acre)			(ratio)		
Black									
Base Case (5%)	-107.83	-267.55	-201.35	-8.65	-21.47	-16.16	0.95	0.94	0.95
Discount rate 3%	-72.30	-287.59	-221.60	-4.86	-19.33	-14.89	0.97	0.95	0.96
Discount rate 7%	-133.10	-248.24	-182.58	-12.56	-23.43	-17.23	0.93	0.93	0.95
Discount rate 10%	-157.75	-221.54	-157.52	-18.53	-26.02	-18.50	0.90	0.92	0.94
Tax Rate 30%	-	-	-168.26	-	-	-13.50	-	-	0.96
Gray									
Base Case (5%)	-86.50	-248.50	-186.11	-6.94	-19.94	-14.93	0.96	0.94	0.96
Discount rate 3%	-46.94	-265.06	-203.57	-3.16	-17.82	-13.68	0.98	0.95	0.96
Discount rate 7%	-114.88	-231.89	-169.50	-10.84	-21.89	-16.00	0.94	0.94	0.95
Discount rate 10%	-143.01	-208.21	-146.85	-16.80	-24.46	-17.25	0.91	0.93	0.95
Tax rate 30%	-	-	-154.92	-	-	-12.43	-	-	0.96

1. Based on a 20-year project.

APPENDIX VIII A
ECONOMIC ANALYSIS: RANGE CONVERSION

Rangeland Conversion with Reduced Herd Size	NPV --($/acre)--	AECF	B/C (ratio)
1. Brown soils			
a. Base case[1] (288 acres)	226.51	29.33	2.04
b. Discount rate 3%	261.34	30.64	2.15
c. Discount rate 7%	197.11	28.06	1.95
d. 10% decrease in gross revenue	7.94	1.03	1.04
e. 20% decrease in gross revenue	-17.11	-2.22	0.92
f. 10% increase in costs	204.76	26.52	1.86
g. 20% increase in costs	183.01	23.70	1.70
h. Residual land value included	254.14	32.91	2.17
2. Dark Brown soils			
a. Base case (144 acres)	333.46	43.18	2.06
b. Discount rate 3%	382.92	44.89	2.16
c. Discount rate 7%	291.69	41.53	1.98
d. 10% decrease in gross revenue	6.68	0.87	1.02
e. 20% decrease in gross revenue	-28.95	-3.75	0.91
f. 10% increase in costs	302.07	39.12	1.87
g. 20% increase in costs	270.67	35.05	1.72
h. Residual land value included	361.09	46.76	2.15
3. Black soils			
a. Base case (208 acres)	310.06	40.15	1.82
b. Discount rate 3%	355.90	41.72	1.89
c. Discount rate 7%	271.32	38.63	1.76
d. 10% decrease in gross revenue	51.91	6.72	1.14
e. 20% decrease in gross revenue	3.97	0.51	1.01
f. 10% increase in costs	272.11	35.24	1.65
g. 20% increase in costs	234.16	30.32	1.51
h. Residual land value included	337.69	43.73	1.89
4. Gray soils			
a. Base case (296 acres)	260.14	33.69	1.95
b. Discount rate 3%	296.59	34.77	2.02
c. Discount rate 7%	228.98	32.60	1.90
d. 10% decrease in gross revenue	66.33	8.59	1.24
e. 20% decrease in gross revenue	28.68	3.71	1.11
f. 10% increase in costs	232.88	30.16	1.78
g. 20% increase in costs	205.62	26.63	1.63
h. Residual land value included	287.76	37.27	2.06

1. Discount rate = 5 per cent; annuity factor = 7.722.

APPENDIX VIII B

FINANCIAL ANALYSIS: RANGE CONVERSION [1]
WITH RESIDUAL VALUE

Case	NPV ($ /acre)			AECF ($ /acre)			B/C (ratio)		
	Total Resources	After Fin.	After Fin&Tax	Total Resources	After Fin	After Fin&Tax	Total Resources	After Fin.	After Fin&Tax
Gray									
Base Case (5%)	320.78	277.47	236.64	41.54	35.93	30.65	2.09	1.57	1.44
Discount rate 3%	366.07	310.14	264.29	42.91	36.36	30.98	2.15	1.57	1.45
Discount rate 7%	282.27	249.17	212.70	40.19	35.48	30.28	2.03	1.56	1.44
Discount rate 10%	234.76	213.49	182.54	38.21	34.74	29.71	1.95	1.56	1.44
Tax rate 30%	-	-	216.23	-	-	28.00	-	-	1.39
Black									
Base Case (5%)	374.10	299.29	261.06	48.45	38.76	33.81	1.93	1.44	1.36
Discount rate 3%	428.97	329.67	287.90	50.29	38.65	33.75	2.00	1.43	1.36
Discount rate 7%	327.83	272.40	237.31	46.68	38.78	33.79	1.87	1.44	1.36
Discount rate 10%	271.41	237.81	206.81	44.17	38.70	33.66	1.79	1.44	1.36
Tax Rate 30%	-	-	241.95	-	-	31.33	-	-	1.33
Dark Brown									
Base Case (5%)	388.06	319.00	274.32	50.26	41.31	35.53	2.15	1.56	1.45
Discount rate 3%	446.36	355.14	305.30	52.33	41.63	35.79	2.26	1.57	1.46
Discount rate 7%	338.94	287.74	247.49	48.26	40.97	35.24	2.06	1.56	1.44
Discount rate 10%	279.14	248.51	213.83	45.43	40.44	34.80	1.95	1.54	1.44
Tax Rate 30%	-	-	251.98	-	-	32.63	-	-	1.40
Brown									
Base Case (5%)	279.20	219.67	192.39	36.16	28.45	24.91	2.16	1.48	1.39
Discount Rate 3%	322.42	243.70	213.36	37.80	28.57	25.01	2.28	1.48	1.39
Discount Rate 7%	242.84	198.59	173.98	34.58	28.27	24.77	2.06	1.47	1.39
Discount Rate 10%	198.62	171.74	150.53	32.33	27.95	24.50	1.94	1.47	1.39
Tax Rate 30%	-	-	178.74	-	-	23.15	-	-	1.36

1. Based on a 10-year project.

APPENDIX VIII C

FINANCIAL ANALYSIS: RANGE CONVERSION [1]
NO RESIDUAL VALUE

Case	NPV ($ /acre)			AECF ($ /acre)			B/C (ratio)		
	Total Resources	After Fin.	After Fin&Tax	Total Resources	After Fin	After Fin&Tax	Total Resources	After Fin.	After Fin&Tax
Gray									
Base Case (5%)	293.15	249.85	211.78	37.96	32.36	27.43	1.99	1.51	1.40
Discount rate 3%	332.59	276.65	234.15	38.99	32.43	27.45	2.05	1.51	1.40
Discount rate 7%	259.40	226.29	192.11	36.93	32.22	27.35	1.94	1.51	1.40
Discount rate 10%	217.41	196.14	166.93	35.38	31.92	27.17	1.88	1.51	1.41
Tax rate 30%	-	-	192.74	-	-	24.96	-	-	1.35
Black									
Base Case (5%)	346.48	271.66	236.20	44.87	35.18	30.59	1.86	1.40	1.33
Discount rate 3%	395.49	296.19	257.77	46.36	34.72	30.22	1.93	1.39	1.32
Discount rate 7%	304.95	249.52	216.72	43.42	35.53	30.86	1.81	1.40	1.33
Discount rate 10%	254.06	220.46	191.19	41.35	35.88	31.12	1.74	1.41	1.34
Tax Rate 30%	-	-	218.46	-	-	28.29	-	-	1.30
Dark Brown									
Base Case (5%)	360.44	291.37	249.46	46.68	37.73	32.31	2.07	1.52	1.41
Discount rate 3%	412.88	321.65	275.17	48.40	37.71	32.26	2.16	1.52	1.41
Discount rate 7%	316.06	264.86	226.91	45.00	37.71	32.31	1.99	1.51	1.41
Discount rate 10%	261.79	231.17	198.21	42.61	37.62	32.26	1.89	1.51	1.41
Tax Rate 30%	-	-	228.50	-	-	29.59	-	-	1.36
Brown									
Base Case (5%)	251.58	192.04	167.52	32.58	24.87	21.69	2.05	1.42	1.34
Discount Rate 3%	288.94	210.22	183.23	33.87	24.64	21.48	2.15	1.41	1.34
Discount Rate 7%	219.97	175.71	153.39	31.32	25.02	21.84	1.96	1.42	1.35
Discount Rate 10%	181.27	154.39	134.92	29.50	25.13	21.96	1.86	1.42	1.35
Tax Rate 30%	-	-	155.26	-	-	20.11	-	-	1.31

1. Based on a 10-year project.

APPENDIX IX A

ECONOMIC ANALYSIS: WOODLAND CONVERSION

	NPV	AECF	B/C
	--($/acre)-		(ratio)
1. Black soils			
a. Base case	710.15	50.39	1.68
b. 3% discount rate	948.71	67.31	1.75
c. 7% discount rate	537.08	38.11	1.61
d. 10% increase in yields or prices	885.21	62.81	1.85
e. 20% increase in yields or prices	1060.13	75.22	2.02
f. 10% decrease in yields or prices	535.11	37.97	1.51
g. 20% decrease in yields or prices	360.19	25.56	1.35
h. 10% increase in investment	688.73	48.87	1.65
i. 10% decrease in investment	731.58	51.91	1.72
j. 10% increase in production costs	627.51	44.52	1.56
k. 20% increase in production costs	544.93	38.66	1.45
l. 10% decrease in production costs	792.75	56.25	1.83
m. 20% decrease in production costs	875.36	62.11	2.00
n. 20% decrease in yield, 20% decrease in price, discount rate 7%	29.08	2.06	1.03
o. Residual value	1150.89	81.66	2.11
2. Gray soils			
a. Base case	306.77	21.77	1.39
b. 3% discount rate	442.37	31.39	1.47
c. 7% discount rate	209.12	14.84	1.31
d. 10% increase in yields or prices	415.98	29.51	1.53
e. 20% increase in yields or prices	525.19	37.26	1.67
f. 10% decrease in yields or prices	197.58	14.02	1.25
g. 20% decrease in yields or prices	88.37	6.27	1.11
h. 10% increase in investment	285.21	20.24	1.35
i. 10% decrease in investment	328.21	23.29	1.43
j. 10% increase in production costs	249.69	17.72	1.30
k. 20% increase in production costs	192.55	13.66	1.21
l. 10% decrease in production costs	363.85	25.82	1.50
m. 20% decrease in production costs	421.00	29.87	1.63
n. 20% decrease in yield, 20% decrease in price, discount rate 7%	(107.92)	(7.66)	0.84
o. Residual value	565.05	40.09	1.72

APPENDIX IX B

FINANCIAL ANALYSIS: WOODLAND CONVERSION [1]
WITH RESIDUAL VALUE

Case	NPV ($ /acre)			AECF ($ /acre)			B/C (ratio)		
	Total Resources	After Fin.	After Fin&Tax	Total Resources	After Fin	After Fin&Tax	Total Resources	After Fin.	After Fin&Tax
Gray									
Base Case (5%)	432.63	363.72	307.52	30.70	25.81	21.82	1.51	1.31	1.25
Discount rate 3%	623.79	526.85	438.93	35.82	30.26	25.21	1.62	1.39	1.30
Discount rate 7%	299.39	253.82	219.70	25.70	21.79	18.86	1.42	1.25	1.21
Discount rate 10%	167.67	150.11	137.66	18.47	16.54	15.17	1.29	1.18	1.16
Tax rate 30%	-	-	279.42	-	-	19.83	-	-	1.22
Black									
Base Case (5%)	836.00	798.30	655.18	59.32	56.64	46.49	1.76	1.56	1.42
Discount rate 3%	1129.77	1066.09	870.33	64.88	61.22	49.98	1.85	1.63	1.46
Discount rate 7%	627.37	611.13	505.55	53.85	52.46	43.39	1.68	1.50	1.38
Discount rate 10%	416.13	425.41	357.90	45.84	46.87	39.43	1.56	1.43	1.34
Tax Rate 30%	-	-	583.63	-	-	41.41	-	-	1.36

1. Based on a 25-year project.

APPENDIX IX C

FINANCIAL ANALYSIS: WOODLAND CONVERSION [1]
NO RESIDUAL VALUE

Case	NPV ($ /acre)			AECF ($ /acre)			B/C (Ratio)		
	Total Resources	After Fin.	After Fin&Tax	Total Resources	After Fin	After Fin&Tax	Total Resources	After Fin.	After Fin&Tax
Gray									
Base Case (5%)	364.71	295.80	246.39	25.88	20.99	17.48	1.43	1.25	1.20
Discount rate 3%	513.94	417.00	340.07	29.51	23.95	19.53	1.51	1.31	1.24
Discount rate 7%	257.02	211.44	181.56	22.06	18.15	15.58	1.36	1.21	1.17
Discount rate 10%	146.44	128.88	118.55	16.13	14.20	13.06	1.25	1.15	1.14
Tax rate 30%	-	-	221.69	-	-	15.73	-	-	1.18
Black									
Base Case (5%)	768.08	730.38	594.06	54.50	51.82	42.15	1.70	1.51	1.38
Discount rate 3%	1019.92	956.24	771.46	58.57	54.92	44.30	1.76	1.57	1.41
Discount rate 7%	584.99	568.75	467.41	50.21	58.82	40.12	1.63	1.47	1.36
Discount rate 10%	394.91	404.18	338.79	43.51	44.53	37.32	1.54	1.41	1.32
Tax Rate 30%	-	-	525.90	-	-	37.31	-	-	1.32

1. Based on a 25-year project.

APPENDIX X A

ECONOMIC ANALYSIS: DRYLAND SALINITY

	NPV	AECF	B/C
	--($/acre)-		(ratio)
a Base	11.03	1.43	1.15
b. Discount rate 3%	15.79	1.85	1.19
c. Discount rate 7%	6.95	0.99	1.10
d. Prices +10%	19.63	2.54	1.26
e. Prices -10%	2.43	0.32	1.03
f. Prices +20%	28.23	3.66	1.38
g. Prices -20%	-6.16	-0.80	0.92
h. Yields +10%	13.62	1.76	1.18
i. Yields -10%	7.87	1.02	1.11
j. Yields +20%	16.78	2.17	1.23
k. Yields -20%	5.28	0.68	1.07
l. Prices and Yields -10%	4.76	0.62	1.06
m. Prices and Yields -20%	-10.75	-1.39	0.86
n. Prices and Yields -20% D.R.=7%	-12.46	-1.77	0.82

APPENDIX X B

FINANCIAL ANALYSIS: RECLAMATION OF SALINIZED LAND - DRYLAND [1]
WITH RESIDUAL VALUE

Case	NPV ($/ acre)			AECF ($/ acre)			B/C (ratio)		
	Total Resources	After Fin.	After Fin&Tax	Total Resources	After Fin	After Fin&Tax	Total Resources	After Fin.	After Fin&Tax
Brown									
Base Case (5%)	175.17	142.86	135.02	22.68	18.50	17.49	1.79	1.29	1.27
Discount rate 3%	216.30	161.73	149.86	25.36	18.96	17.57	1.89	1.29	1.27
Discount rate 7%	141.10	127.28	122.75	20.09	18.12	17.48	1.69	1.28	1.27
Discount rate 10%	100.39	108.64	108.06	16.34	17.68	17.59	1.55	1.27	1.27
Tax rate 30%	-	-	135.02	-	-	17.49	-	-	1.26

1. Based on a 10-year project.

APPENDIX X C

FINANCIAL ANALYSIS: RECLAMATION OF SALINIZED LAND - DRYLAND [1]
NO RESIDUAL VALUE

Case	NPV			AECF			B/C		
	Total Resources	After Fin.	After Fin&Tax	Total Resources	After Fin	After Fin&Tax	Total Resources	After Fin.	After Fin&Tax
	($/ acre)			($/ acre)			(ratio)		
Brown									
Base Case (5%)	52.25	19.95	24.40	6.77	2.58	3.16	1.24	1.04	1.05
Discount rate 3%	67.32	12.75	15.78	7.89	1.49	1.85	1.28	1.02	1.03
Discount rate 7%	39.32	25.50	31.15	5.60	3.63	4.44	1.19	1.06	1.07
Discount rate 10%	23.19	31.45	38.58	3.77	5.12	6.28	1.13	1.08	1.10
Tax rate 30%	-	-	26.62	-	-	3.45	-	-	1.05

1. Based on a 10-year project.

APPENDIX XI A

ECONOMIC ANALYSIS: DRAINAGE OF IRRIGATED SALINE SOILS

BRID	NPV	AECF	B/C
	----($/ac)----		(ratio)
1. High salinity			
a. Base Case[1]	755	49	1.22
b. Discount rate 3%	1 178	60	1.28
c. Discount rate 7%	461	37	1.16
d. Residual value included (50 years)	1 062	69	1.31
e. Residual value (95 years)	1 229	80	1.36
f. 10% increase in yields or prices	1 171	76	1.34
g. 20% increase in yields or prices	1 581	103	1.46
h. 10% decrease in yields or prices	339	22	1.10
i. 20% decrease in yields or prices	-70	-5	0.98
j. 10% increase in production costs	467	30	1.13
k. 20% increase in production costs	186	12	1.05
l. 10% increase in drainage costs	704	46	1.20
m. 20% increase in drainage costs	653	42	1.18
n. Project size 10 acres	307	20	1.22
o. Worst case scenario[2]	-371	-24	0.90
2. Medium salinity			
a. Base Case	877	57	1.26
b. Discount rate 3%	1 312	67	1.31
c. Discount rate 7%	576	46	1.20
d. Residual value included (50 years)	1 184	77	1.35
e. Residual value (95 years)	1 350	88	1.39
f. 10% increase in yields or prices	1 306	85	1.38
g. 20% increase in yields or prices	1 734	113	1.51
h. 10% decrease in yields or prices	448	29	1.13
i. 20% decrease in yields or prices	19	1	1.01
j. 10% increase in production costs	589	38	1.16
k. 20% increase in production costs	307	20	1.08
l. 10% increase in drainage costs	826	54	1.24
m. 20% increase in drainage costs	774	50	1.22
n. Project size 10 acres	358	23	1.26
o. Worst case scenario[2]	-275	-18	0.93

1. Base case = 10-year average yields and prices with 5 per cent discount rate.

2. 10 per cent increase in drainage and production costs plus a 10 per cent decrease in both yields and prices.

APPENDIX XI A (continued)

ECONOMIC ANALYSIS: DRAINAGE OF IRRIGATED SALINE SOILS

LNID	NPV ----($/ac)----	AECF	B/C (ratio)
3. High salinity			
a. Base Case[1]	612	40	1.18
b. Discount rate 3%	992	51	1.23
c. Discount rate 7%	352	28	1.12
d. Residual value included (50 years)	890	58	1.26
e. Residual value (95 years)	1 037	67	1.30
f. 10% increase in yields or prices	1 011	66	1.30
g. 20% increase in yields or prices	1 414	92	1.41
h. 10% decrease in yields or prices	211	14	1.06
i. 20% decrease in yields or prices	-192	-12	0.94
j. 10% increase in production costs	326	21	1.09
k. 20% increase in production costs	38	2	1.01
l. 10% increase in drainage costs	557	36	1.16
m. 20% increase in drainage costs	506	33	1.14
n. Project size 10 acres	250	16	1.18
o. Worst case scenario	-493	-32	0.87
4. Medium salinity			
a. Base Case	712	46	1.20
b. Discount rate 3%	1 114	57	1.25
c. Discount rate 7%	448	36	1.15
d. Residual value included (50 years)	992	65	1.28
e. Residual value (95 years)	1 139	74	1.32
f. 10% increase in yields or prices	1 133	74	1.32
g. 20% increase in yields or prices	1 549	101	1.44
h. 10% decrease in yields or prices	294	19	1.08
i. 20% decrease in yields or prices	-128	-8	0.96
j. 10% increase in production costs	416	27	1.11
k. 20% increase in production costs	122	8	1.03
l. 10% increase in drainage costs	659	43	1.19
m. 20% increase in drainage costs	608	40	1.17
n. Project size 10 acres	288	19	1.20
o. Worst case scenario	-435	-28	0.89

1. Base case = 10-year average yields and prices with 5 per cent discount rate.

APPENDIX XI A (continued)

ECONOMIC ANALYSIS: DRAINAGE OF IRRIGATED SALINE SOILS

EID	NPV	AECF	B/C
	-----($/ac)----		(ratio)
5. High salinity			
a. Base Case[1]	531	35	1.16
b. Discount rate 3%	890	45	1.21
c. Discount rate 7%	288	23	1.10
d. Residual value included (50 years)	794	52	1.24
e. Residual value (95 years)	934	61	1.28
f. 10% increase in yields or prices	915	60	1.27
g. 20% increase in yields or prices	1 306	85	1.39
h. 10% decrease in yields or prices	147	10	1.04
i. 20% decrease in yields or prices	-237	-15	0.93
j. 10% increase in production costs	250	16	1.07
k. 20% increase in production costs	-26	-2	0.99
l. 10% increase in drainage costs	480	31	1.14
m. 20% increase in drainage costs	429	28	1.12
n. Project size 10 acres	218	14	1.16
o. Worst case scenario	-538	-35	0.85
6. Medium salinity			
a. Base Case	631	41	1.18
b. Discount rate 3%	992	51	1.23
c. Discount rate 7%	384	31	1.14
d. Residual value included (50 years)	896	58	1.26
e. Residual value (95 years)	1 037	67	1.30
f. 10% increase in yields or prices	1 037	67	1.30
g. 20% increase in yields or prices	1 440	94	1.42
h. 10% decrease in yields or prices	230	15	1.07
i. 20% decrease in yields or prices	-173	11	0.95
j. 10% increase in production costs	346	22	1.09
k. 20% increase in production costs	58	4	1.01
l. 10% increase in drainage costs	576	37	1.17
m. 20% increase in drainage costs	525	34	1.15
n. Project size 10 acres	256	17	1.19
o. Worst case scenario	-474	-31	0.87

1. Base case = 10-year average yields and prices with 5 per cent discount rate.

APPENDIX XI B

FINANCIAL ANALYSIS: RECLAMATION OF SALINIZED LAND - IRRIGATED (BRID)

Salinity Level	NPV ($/ac) Total Res.	NPV ($/ac) After Fin.	NPV ($/ac) After Fin. & Tax	AECF ($/ac) Total Res.	AECF ($/ac) After Fin.	AECF ($/ac) After Fin. & Tax	B/C (ratio) Total Res.	B/C (ratio) After Fin.	B/C (ratio) After Fin.&Tax
High									
Base Case[1]	809	675	576	53	44	37	1.22	1.15	1.13
Discount Rate 3%	1 369	1 170	974	70	60	50	1.30	1.22	1.18
Discount Rate 7%	443	363	328	36	29	26	1.15	1.10	1.09
Discount Rate 10%	105	90	113	11	10	12	1.04	1.03	1.04
Marginal Tax Rate 30%	809	675	527	53	44	34	1.22	1.15	1.12
No Residual Value, 20% Tax Rate	684	549	463	44	36	30	1.19	1.12	1.10
No Residual Value, 30% Tax Rate	684	549	420	44	36	27	1.19	1.12	1.09
Medium									
Base Case	928	793	671	60	51	44	1.25	1.18	1.15
Discount Rate 3%	1 494	1 296	1 074	76	66	55	1.33	1.24	1.19
Discount Rate 7%	555	474	417	45	38	34	1.18	1.13	1.11
Discount Rate 10%	207	192	195	22	20	21	1.09	1.06	1.06
Marginal Tax Rate 30%	928	793	609	60	51	40	1.25	1.18	1.13
No Residual Value, 20% Tax Rate	802	667	558	52	43	36	1.22	1.15	1.12
No Residual Value, 30% Tax Rate	802	667	503	52	43	33	1.22	1.15	1.11

1. Base Case: 5 per cent discount rate, 20 per cent marginal tax rate, residual value included.

APPENDIX XI C

FINANCIAL ANALYSIS: RECLAMATION OF SALINIZED LAND - IRRIGATED (LNID)

Salinity Level	NPV ($/ac)			AECF ($/ac)			B/C (ratio)		
	Total Res.	After Fin.	After Fin. & Tax	Total Res.	After Fin.	After Fin. & Tax	Total Res.	After Fin.	After Fin.&Tax
High									
Base Case[1]	660	525	457	43	34	30	1.18	1.12	1.10
Discount Rate 3%	1 171	973	816	60	50	42	1.26	1.18	1.15
Discount Rate 7%	329	248	236	27	20	19	1.11	1.07	1.06
Discount Rate 10%	26	11	50	3	1	5	1.01	1.00	1.02
Marginal Tax Rate 30%	660	525	422	43	34	27	1.18	1.12	1.09
No Residual Value, 20% Tax Rate	535	400	343	35	26	22	1.15	1.09	1.08
No Residual Value, 30% Tax Rate	535	400	316	35	26	21	1.15	1.09	1.07
Medium									
Base Case	755	620	532	49	40	35	1.20	1.14	1.12
Discount Rate 3%	1 272	1 074	897	65	55	46	1.27	1.20	1.16
Discount Rate 7%	417	336	306	34	27	25	1.13	1.09	1.08
Discount Rate 10%	104	89	113	11	9	12	1.04	1.03	1.04
Marginal Tax Rate 30%	755	620	488	49	40	32	1.20	1.14	1.11
No Residual Value, 20% Tax Rate	629	494	419	41	32	27	1.17	1.11	1.09
No Residual Value, 30% Tax Rate	629	494	382	41	32	25	1.17	1.11	1.08

1. Base Case: 5 per cent discount rate, 20 per cent marginal tax rate, residual value included.

APPENDIX XI D

FINANCIAL ANALYSIS: RECLAMATION OF SALINIZED LAND - IRRIGATED (EID)

Salinity Level	NPV ($/ac) Total Res.	NPV ($/ac) After Fin.	NPV ($/ac) After Fin. & Tax	AECF ($/ac) Total Res.	AECF ($/ac) After Fin.	AECF ($/ac) After Fin. & Tax	B/C (ratio) Total Res.	B/C (ratio) After Fin.	B/C (ratio) After Fin.&Tax
High									
Base Case[1]	583	449	395	38	29	26	1.16	1.10	1.09
Discount Rate 3%	1 071	873	736	55	45	38	1.24	1.16	1.14
Discount Rate 7%	267	187	187	22	15	15	1.09	1.05	1.05
Discount Rate 10%	-20	-35	-13	-2	-4	1.4	0.99	0.99	1.00
Marginal Tax Rate 30%	583	449	368	38	29	24	1.16	1.10	1.08
No Residual Value, 20% Tax Rate	457	323	282	30	21	18	1.13	1.07	1.06
No Residual Value, 30% Tax Rate	457	323	261	30	21	17	1.13	1.07	1.06
Medium									
Base Case	677	543	470	44	35	31	1.19	1.12	1.10
Discount Rate 3%	1 173	975	818	60	50	42	1.26	1.18	1.15
Discount Rate 7%	355	274	257	29	22	21	1.12	1.07	1.07
Discount Rate 10%	58	43	76	6	5	8	1.02	1.01	1.03
Marginal Tax Rate 30%	671	543	434	44	35	28	1.19	1.12	1.10
No Residual Value, 20% Tax Rate	552	417	357	36	27	23	1.15	1.09	1.08
No Residual Value, 30% Tax Rate	552	417	327	36	27	21	1.15	1.09	1.07

1. Base Case: 5 per cent discount rate, 20 per cent marginal tax rate, residual value included.